1989 MANITOBA SWINE SEMINAR

UNDERSTANDING PRODUCTION PROBLEMS

February 22 & 23, 1989

Manitoba Agriculture

89-04883/

AGENDA

"UNDERSTANDING PRODUCTION PROBLEMS"

Wednesday, February 22, 1989

Chairman: Dr. M. Sheridan, Swine Practitioner, Steinbach, MB

9:15 a.m. COFFEE & REGISTRATION

10:00 a.m. **Diagnosing Problems Through Records**
- Dr. L. Rueff, Swine Practitioner, Greensburg, Indiana.

10:45-11:00 Questions & Discussion

11:00 a.m. **Piglet Deaths: Insights from Behaviour**
- Dr. D. Fraser, Animal Research Centre, Ottawa, Ontario.

11:45-12:00 Questions & Discussion

12:00 Noon LUNCH

1:30 p.m. **Getting Feed Intake Right in the Sow Herd**
- Dr. F. Aherne, University of Alberta, Edmonton, AB

2:15-2:30 Questions & Discussion

2:30 p.m. COFFEE

2:45-3:15 **Environments to Enhance Farrowing Barn Performance**
- H. Huffman, Ontario Ministry of Agriculture and Food, Woodstock, Ontario.

3:15-3:45 **Common Performance Barriers in Farrowing & Nursery Facilities**
- F. Kains, Ontario Ministry of Agriculture and Food, Guelph, Ontario.

3:45-4:00 Questions & Discussion

7:00-9:30 p.m. **Diagnosing Common Production Problems**
- Panel discussion with speakers and other resource people.

Thursday, February 23, 1989

CHAIRMAN:	D. Hodgkinson, Agricultural Engineer, Manitoba Agriculture, Winnipeg, Manitoba.
9:15 a.m.	COFFEE & REGISTRATION
10:00 a.m.	**Tail-Biting: A Few Ruminations** - Dr. D. Fraser, Animal Research Centre, Ottawa, Ontario.
10:30-10:40	Questions & Discussion
10:40-11:10	**Facility Problems in the Feeder Barn** - F. Kains, Ontario Ministry of Agriculture and Food, Guelph, Ontario.
11:10-11:20	Questions & Discussion
11:20-11:50	**Improving Feeder Barn Management - Some Common Shortcomings** - Dr. F. Aherne, University of Alberta, Edmonton, AB
11:50-12 Noon	Questions & Discussion
12:00 Noon	LUNCH
1:30-2:00	**Attacking Ventilation Problems** - H. Huffman, Ontario Ministry of Agriculture and Food, Woodstock, Ontario.
2:00-2:10	Questions & Discussion
2:10-2:50	**Formulating A Game Plan to Achieve Production Targets** - Dr. L. Rueff, Swine Practitioner, Greensburg, Indiana.
2:50-3:00	Questions & Discussion
3:00-3:15	COFFEE
3:15-3:35	**Separating Fact from Fiction - Getting Information You Can Trust** - Dr. F. Aherne, University of Alberta, Edmonton, AB
3:35-3:45	Questions & Discussion
3:45-4:05	**"A Pig's a Pig for a' That"** - Dr. D. Fraser, Animal Research Centre, Ottawa, Ontario.

ADJOURNMENT

VIDEOTAPES (VHS format) of all presentations are available by contacting:

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Formulating A Game Plan to Achieve Production Targets	White Sheets

The following pages represent a handout given to the audience during Dr. Rueff's presentation. Remarks during the presentation referrred to specific points in the handout and are available on video tape. Please contact the people listed in the front of these proceedings if you wish to obtain the tape.

SWINE VETERINARY SERVICES, P.C.

HIGHWAY 46 WEST P.O. BOX 133
GREENSBURG, INDIANA 47240
(812) 663-5731

LARRY RUEFF, D.V.M. ED KLUBER, D.V.M., M.S.

DIAGNOSING PROBLEMS THROUGH RECORDS

Larry Rueff, DVM
Greensburg, Indiana

February 22, 1989

PERFORMANCE MONITOR
1 JUL 87 - 30 JUN 88
FARM:

PigCHAMP 2.
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	JUL 87 SEP 87	OCT 87 DEC 87	JAN 88 MAR 88	APR 88 JUN 88	JUL 8 JUN 8
BREEDING PERFORMANCE					
Total number of services	243	242	247	235	(1) 967
Percent repeat services	4.5	4.5	6.5	5.1	(2) 5.2
Percent multiple matings	96.3	94.2	95.1	94.9	(3) 95.1
Weaning - 1st service interval	7.6	10.7	10.0	9.0	(4) 9.3
Percent sows bred by 7 days	87.1	82.4	77.2	82.2	82.2
Entry - 1st service interval	55	57	54	52	55
Ave non-productive sow days	67.9	67.9	66.7	61.3	66.0
FARROWING PERFORMANCE					
Number of sows farrowed	222	221	226	216	885
Ave parity of farrowed sows	3.5	3.6	3.4	3.7	3.5
Total pigs born alive	2288	2426	2405	2293	9412
Average total pigs per litter	11.2	11.8	11.7	11.6	11.6
Average pigs born alive/litter	10.3	11.0	10.6	10.6	(5) 10.6
Average stillborn pigs	0.7	0.5	0.8	0.8	(6) 0.7
Percent stillborn pigs	6.2	4.6	7.1	6.9	6.2
Average mummies per litter	0.2	0.2	0.2	0.2	0.2
Percent mummies	1.7	2.0	1.7	2.0	1.9
Average litter birth weight	31.8	34.4	33.0	32.7	33.0
Farrowing rate	88.4	90.6	88.6	90.4	(7) 89.5
Farrowing interval	151	150	150	152	151
Pigs weaned per sow farrowed	9.2	9.5	9.4	9.4	9.4
Litters / mated female / year	2.31	2.29	2.34	2.26	(8) 2.30
Litters / female / year	2.14	2.13	2.17	2.10	2.14
WEANING PERFORMANCE					
Number of litters weaned	219	233	227	218	897
Total pigs weaned	2031	2174	2152	2011	8368
Pigs weaned per litter	9.3	9.3	9.5	9.2	(9) 9.3
Pre-weaning mortality	11.2	13.7	11.1	12.2	(10) 12.1
Average weaning weight	14.5	14.8	15.1	14.8	14.8
Average age at weaning	25.8	25.0	24.3	25.4	25.1
Adjusted 21 day litter weight	122	130	131	124	127
Pigs weaned/mated female/year	21.3	22.6	22.4	20.9	(11) 21.8
Pigs weaned / female / year	19.9	20.9	20.6	19.5	20.2
POPULATION					
Ending female inventory	423	417	413	421	421
Average parity	2.5	2.5	2.6	2.5	2.5
Average female inventory	414.4	416.8	411.5	404.0	411.7
Average gilt pool inventory	30.6	29.4	30.9	25.7	29.1
Gilts entered	62	42	43	55	202
Sows and gilts culled	39	42	43	44	168
Sow and gilt deaths	9	6	4	3	22
Sows and gilts transferred	0	0	0	0	0
Ending boar inventory	24	27	27	30	30
Replacement rate	59.4	40.0	41.9	54.6	(12) 48.9
Culling rate	37.3	40.0	41.9	43.7	40.7
Death rate	8.6	5.7	3.9	3.0	(13) 5.3

PARITY DISTRIBUTION REPORT
1 JUL 87 - 30 JUN 88
FARM.

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	PARITY								ENTIRE
	0	1	2	3	4	5	6	7+	HERD
BREEDING PERFORMANCE									
Total number of services	198	175	155	135	110	91	69	34	967
Percent repeat services	8.1	7.4	5.8	2.2	4.5	3.3	0.0	2.9	5.2
Percent multiple matings	94.4	93.1	94.8	97.8	93.6	97.8	98.6	91.2	95.1
Weaning - 1st service interval	.	19.2	(1) 7.7	6.7	5.9	6.3	5.9	4.9	9.3
Percent sows bred by 7 days	0.0	49.4	87.7	89.4	93.3	94.3	92.8	100.0	82.2
Ave non-productive sow days	27.0	9.2	-42.7	-46.3	-40.0	-31.2	-24.4	55.4	-10.7
FARROWING PERFORMANCE									
Number of sows farrowed	0	176	161	145	122	105	83	93	885
Total pigs born alive	.	1723	1728	1588	1344	1144	927	958	9412
Average total pigs per litter	.	10.6	11.4	11.9	12.0	12.1	12.3	11.4	11.6
Average pigs born alive/litter	.	9.8	(2) 10.7	11.0	11.0	10.9	11.2	10.3	10.6
Average stillborn pigs	.	0.6	0.5	0.7	0.7	1.0	0.9	0.8	0.7
Percent stillborn pigs	.	5.9	4.7	6.0	6.0	7.8	7.3	7.2	6.2
Average mummies per litter	.	0.1	0.2	0.3	0.2	0.3	0.2	0.2	0.2
Percent mummies	.	1.3	1.5	2.2	2.1	2.4	1.7	2.2	1.9
Litters less than 7 born live	.	13	12	4	6	4	3	9	51
Percent < 7 born live	.	7.4	7.5	2.8	4.9	3.8	3.6	9.7	5.8
Average litter birth weight	.	31.6	34.0	34.2	34.0	32.2	33.0	31.2	33.0
Farrowing rate	.	86.3	(3) 90.4	90.1	93.8	89.7	90.2	86.9	89.5
Farrowing interval	.	.	160	149	147	149	147	147	151
WEANING PERFORMANCE									
Number of litters weaned	0	179	160	146	121	107	86	98	897
Total pigs weaned	.	1706	1490	1359	1169	950	762	932	8368
Pigs weaned per litter	.	9.5	9.3	9.3	9.7	8.9	8.9	9.5	9.3
Pre-weaning mortality	.	8.9	13.5	13.2	12.3	12.2	12.3	13.1	12.1
Net foster	.	131	-5	-24	-4	-50	-100	63	11
Average weaning weight	.	14.0	14.6	14.8	15.0	15.2	15.1	15.6	14.8
Average age at weaning	.	24.6	25.6	25.2	24.6	24.8	25.4	26.0	25.1
Adjusted 21 day litter weight	.	127	122	126	132	126	124	131	127
POPULATION									
Ending female inventory	(4) 96	75	61	49	53	40	24	23	421
Percent of female inventory	22.8	17.8	14.5	11.6	12.6	9.5	5.7	5.5	100.0
Females entered	202	0	0	0	0	0	0	0	202
Sows and gilts culled	13	11	9	17	18	20	22	58	168
Sow and gilt deaths	3	7	5	4	0	2	0	1	22
Average female inventory	88.3	82.3	61.5	53.3	44.0	38.2	28.8	20.9	417.3

PARITY DISTRIBUTION REPORT
1 SEP 86 - 30 SEP 88
FARM:

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	PARITY							ENTIRE
	0	1	2	3	4	5	6+	HERD
BREEDING PERFORMANCE								
Total number of services	152	134	125	113	40	0	0	564
Percent repeat services	3.9	0.0	0.8	0.9	0.0	.	.	1.4
Percent multiple matings	0.0	0.0	1.6	2.7	0.0	.	.	0.9
Weaning - 1st service interval	.	17.7	21.6	21.8	21.0	.	.	20.3
Percent sows bred by 7 days	0.0	23.1	6.5	0.0	0.0	.	.	9.5
Ave non-productive sow days	41.8	-41.4	-35.5	-28.7	47.1	.	.	-7.9
FARROWING PERFORMANCE								
Number of sows farrowed	0	123	128	121	111	35	0	518
Total pigs born alive	.	1233	1464	1371	1263	357	.	5688
Average total pigs per litter	.	11.0	12.4	12.7	12.4	11.5	.	12.1
Average pigs born alive/litter	.	10.0	11.4	11.3	11.4	10.2	.	11.0
Average stillborn pigs	.	(1) 1.0	1.0	1.3	1.0	1.3	.	1.1
Percent stillborn pigs	.	8.7	7.8	10.5	8.0	11.2	.	8.9
Average mummies per litter	.	0.0	0.0	0.0	0.0	0.0	.	0.0
Percent mummies	.	0.0	0.0	0.0	0.0	0.0	.	0.0
Litters less than 7 born live	.	11	7	2	5	3	.	28
Percent < 7 born live	.	8.9	5.5	1.7	4.5	8.6	.	5.4
Average litter birth weight	.	.	.	.	.	.	.	.
Farrowing rate	.	66.1	88.3	87.1	81.6	77.8	.	79.6
Farrowing interval	.	.	170	181	183	179	.	178
WEANING PERFORMANCE								
Number of litters weaned	0	135	128	121	115	35	0	534
Total pigs weaned	.	1179	1240	1128	1037	258	.	4842
Pigs weaned per litter	.	(2) 8.7	9.7	9.3	9.0	7.4	.	9.1
Pre-weaning mortality	.	12.2	15.9	16.9	20.6	27.3	.	17.0
Net foster	.	0	10	-13	4	-2	.	-1
Average weaning weight	.	.	.	.	.	.	.	.
Average age at weaning	.	32.6	37.5	38.1	36.2	30.5	.	35.6
Adjusted 21 day litter weight	.	.	.	.	.	.	.	.
POPULATION								
Ending female inventory	93	7	0	0	0	0	0	100
Percent of female inventory	93.0	7.0	.	.	.	.	.	100.0
Females entered	146	0	0	0	0	0	0	146
Sows and gilts culled	4	7	7	13	111	35	0	177
Sow and gilt deaths	0	0	1	0	0	0	0	1
Average female inventory	25.4	29.7	30.1	27.9	14.9	2.3	0.0	130.4

BREEDING PERFORMANCE
1 OCT 85 - 30 NOV 87
FARM:

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BREEDING PERFORMANCE SUMMARY

	PARITY 0	1	2	3	4 - 6	7+	TOTAL
NUMBER OF SERVICES	448	376	336	292	578	121	2151
KNOWN SERVICE RESULTS	448	376	336	292	578	121	2151
NUMBER FARROWED	378	335	308	266	498	96	1881
FARROWING RATE (%)	84.4	89.1	91.7	91.1	86.2	79.3	(1) 87.4
NUMBER NOT FARROWING	70	41	28	26	80	25	270
NON-FARROWING RATE (%)	15.6	10.9	8.3	8.9	13.8	20.7	12.6
Returned to service	53	23	19	9	30	4	138
Repeat service rate (%)	11.8	6.1	5.7	3.1	5.2	3.3	(2) 6.4
Negative pregnancy test	2	5	1	1	1	0	(3) 10
Neg. preg. test rate (%)	0.4	1.3	0.3	0.3	0.2	0.0	0.5
Abortions	2	0	1	0	2	0	(4) 5
Abortion rate (%)	0.4	0.0	0.3	0.0	0.3	0.0	0.2
Failed to farrow	4	10	1	0	9	1	(5) 25
Failure to farrow rate (%)	0.9	2.7	0.3	0.0	1.6	0.8	1.2
Other non-farrowers	9	3	6	16	38	(7) 20	(6) 92
Other non-farrowers (%)	2.0	0.8	1.8	5.5	6.6	16.5	4.3
UNKNOWN SERVICE RESULTS	0	0	0	0	0	0	0

Sows selected for the breeding performance report were served in the report period.

All rate calculations are based on records where the service results are known. Sows with services as last events are not included in the denominator.

BREEDING PERFORMANCE
1 OCT 87 - 31 AUG 88
FARM:

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BREEDING PERFORMANCE SUMMARY

	PARITY 0	1	2	3 - 6	7+	TOTAL
NUMBER OF SERVICES	322	189	130	176	48	865
KNOWN SERVICE RESULTS	321	189	130	176	48	864
NUMBER FARROWED	266	131	92	106	29	624
FARROWING RATE (%)	82.9	69.3	70.8	60.2	60.4	72.2
NUMBER NOT FARROWING	55	58	38	70	19	240
NON-FARROWING RATE (%)	17.1	30.7	29.2	39.8	39.6	27.8
Returned to service	29	37	21	47	12	146
Repeat service rate (%)	9.0	19.6	16.2	26.7	25.0	16.9
Negative pregnancy test	6	1	0	4	0	11
Neg. preg. test rate (%)	1.9	0.5	0.0	2.3	0.0	1.3
Abortions	0	0	0	1	0	1
Abortion rate (%)	0.0	0.0	0.0	0.6	0.0	0.1
Failed to farrow	6	13	5	4	2	30
Failure to farrow rate (%)	1.9	6.9	3.8	2.3	4.2	3.5
Other non-farrowers	14	7	12	14	5	52
Other non-farrowers (%)	4.4	3.7	9.2	8.0	10.4	6.0
UNKNOWN SERVICE RESULTS	1	0	0	0	0	1

Sows selected for the breeding performance report were served in the report period.

All rate calculations are based on records where the service results are known. Sows with services as last events are not included in the denominator.

GENETICS COMPARISON REPORT
1 JUN 86 - 30 JUN 87
FARM:

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PARITY: 1

		Y	L	X	TOTAL
BREEDING PERFORMANCE					
Total number of services		51	45	108	210
Percent repeat services		9.8	15.6	5.6	8.6
Percent multiple matings		68.6	44.4	79.6	69.0
Weaning - 1st service interval		8.2	8.7	8.1	8.4
Percent sows bred by 7 days		60.9	57.9	60.8	58.9
Ave non-productive sow days		40.0	82.6	-15.1	24.9
FARROWING PERFORMANCE					
Number of sows farrowed		66	63	108	244
Total pigs born alive		576	589	992	2228
Average total pigs per litter		9.7	10.0	9.9	9.9
Average pigs born alive/litter	(1)	8.7	9.3	9.2	9.1
Average stillborn pigs		1.0	0.6	0.7	0.7
Percent stillborn pigs		10.0	5.7	6.9	7.4
Average mummies per litter		0.0	0.1	0.0	0.0
Percent mummies		0.5	0.6	0.0	0.3
Litters less than 7 born live		18	5	15	38
Percent < 7 born live		27.3	7.9	13.9	15.6
Average litter birth weight		.	.	.	.
Farrowing rate	(2)	74.2	85.1	90.8	84.1
Farrowing interval		.	.	.	.
WEANING PERFORMANCE					
Number of litters weaned		66	63	126	262
Total pigs weaned		514	540	1107	2222
Pigs weaned per litter	(3)	7.8	8.6	8.8	8.5
Pre-weaning mortality		16.7	6.3	6.3	9.2
Net foster		41	-13	1	29
Average weaning weight		14.8	15.5	15.6	15.5
Average age at weaning		24.2	24.1	26.9	25.8
Adjusted 21 day litter weight		118	136	133	129
POPULATION					
Ending female inventory		4	5	0	13
Percent of female inventory		0.0	0.0	.	0.0
Females entered		0	0	0	0
Sows and gilts culled		15	10	11	37
Sow and gilt deaths		2	0	2	4
Average female inventory		23.7	27.0	48.3	101.7

Piglet Deaths: Insights from Behaviour

Dr. David Fraser

The following three articles cover many of the points raised by Dr. Fraser in his presentation. People wishing a complete review of his presentation should request a copy of the videotape available from the people listed in the front of these proceedings.

Low Litter Weight Gains in the First Three Days After Farrowing: A Harbinger of Problems Ahead?

B.K. Thompson[1] and David Fraser[2]
[1]Engineering and Statistical Research Centre and [2]Animal Research Centre, Research Branch, Agriculture Canada, Ottawa K1A 0C6

Introduction

Piglet weight gains are highly variable in the first and, to a lesser extent, the second week after birth. During the first week, for example, some piglets more than double their birth weights, while others gain only negligible amounts. However, in later weeks of lactation, rate of gain becomes more and more closely associated with a piglet's body weight at that time. During the fifth week, for example, piglets may gain about 30% of the weight they had reached by the end of the fourth week so that a 10-kg piglet tends to gain about twice as much as a 5-kg piglet. At this stage, the established differences in body weight, which resulted from differences in birth weight and in growth during the first few days, simply become more pronounced.

In the present study, we examined in detail the weight gains of piglets in the important first two weeks after birth.

Methods

This study involved 42 litters from Yorkshire sows in the Animal Research Centre's minimum disease herd. The sows were moved into farrowing crates about five days before farrowing was due and remained there, with their litters, until 14 days after birth. Piglets were weighed on days 0, 1, 2, 3, 4, 5, 7, 10 and 14 days after birth.

Litters were adjusted to 10-12 piglets by the time of weighing on day 1. All piglets with physical abnormalities or weighing less than 800 g were removed at this time. The data from piglets which were added to the litters to ensure litters of at least 10 piglets were ignored so the study included data on 391 piglets.

Results

Litters varied remarkably in their growth patterns during the first few days after birth. Figure 1 shows two examples, both involving litters of 10 piglets. In litter 52, the piglets gained at a fairly steady rate of 200 g per day for the first

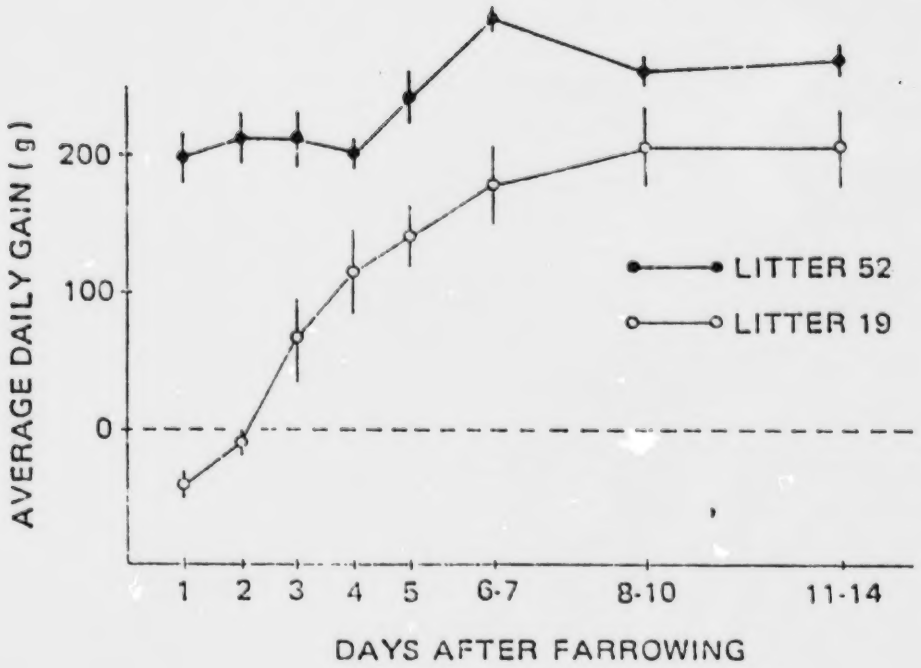

Fig. 1. Mean ± S.E.M. daily gain (g) per piglet in litters 52 and 19, litters which had among the highest and lowest weight gains respectively during days 0-3 after farrowing. Gains are shown for individual days after farrowing, where "day 1" refers to the gain between day 0 and day 1, and so on.

four days after birth, and then at a somewhat higher rate over the next ten days. In litter 19, all piglets lost weight on the first day, and it was not until the fourth day that all piglets had begun to gain. Other patterns were seen occasionally but sudden changes in weight gain, as well as very low gains, were confined to the first three days after birth.

The relationship between early and later gains was studied by comparing the ten litters with the highest gains on days 0-3 ("fast-start litters") and the ten litters with the lowest gains during this period ("slow-start litters"). Two main differences were apparent (Fig. 2). First, the fast-start litters were only slightly heavier at birth than the slow-start litters but were substantially heavier by day 14 ($P<0.01$). Second, the slow-start litters were significantly more variable in their day 14 weights ($P<0.01$), even though the variability of the two types of litters was about the same at birth. It may be noted that there were only two deaths among the fast-start litters, but ten among the slow-start litters, though seven of those deaths occurred in a single litter.

Discussion

In this study, daily weighing of piglets revealed remarkably large differences between litters in weight gains during the first few days after farrowing. Since much of the variation applied to litters as a whole, it probably indicates large differences between sows in the early availablity of milk.

Low yield of milk in the first days after farrowing is a well-known problem with sows, often associated with high rectal temperature, lack of appetite, inflammation of the mammary glands and microbial infections. However, the differences between litters in piglet weight gains in our study cannot be explained based on a simple distinction between sick and healthy sows. because there was little overt evidence of ill health with the sows. In cases such as this where there is no obvious illness, low piglet weight gains may have resulted from subclinical illness of the sow or from some different mechanism such as inadequate hormonal stimulation of milk production.

In this study, there were few deaths, presumably because of the minimum-disease conditions and the controlled hygienic environment. However, a number of other studies, done under more typical commercial conditions than our own, suggest that many piglet deaths occur in litters with low average weight gains early in lactation.

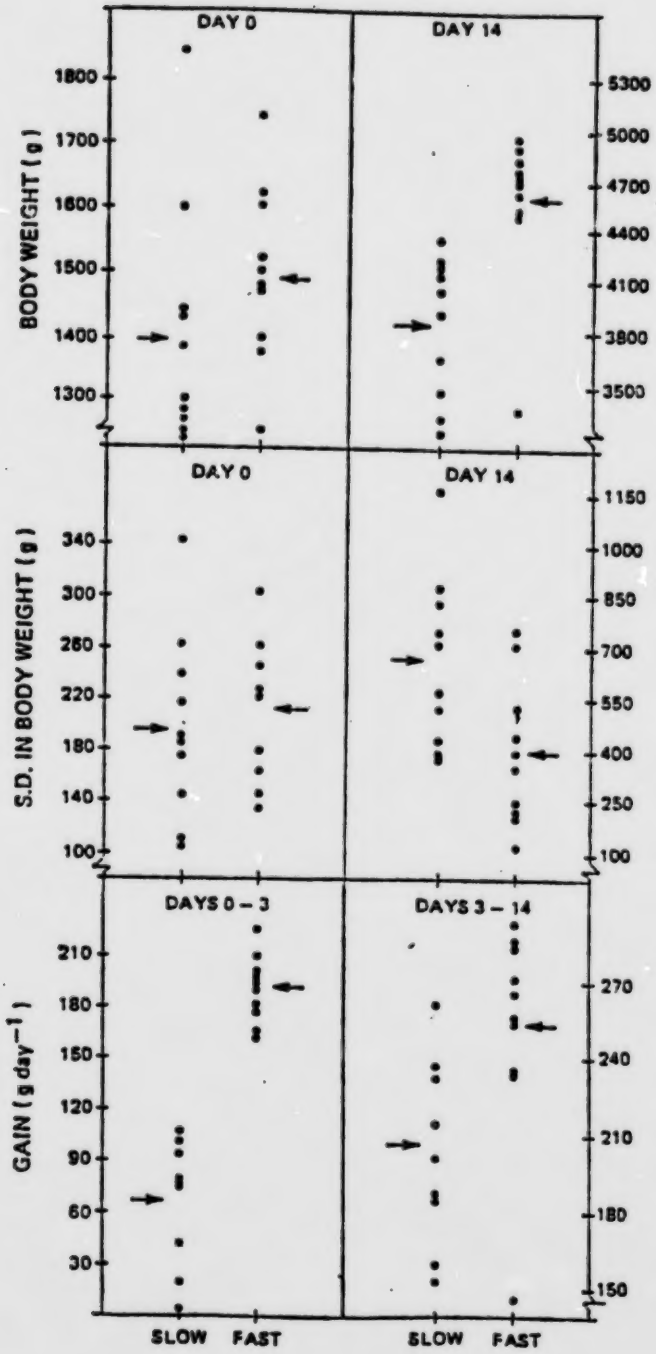

Fig. 2. The litter means and standard deviations of 0-day and 14-day body weights and the litter means of gains during days 0-3 and days 3-14 for the ten "slow-start" and the ten "fast-start" litters. The arrows indicate the means of the means and standard deviations.

Significance to the Industry

Low weight gains during the first few days after birth are an indication that high mortality and low, variable gains may occur later in the lactation. If litters can be monitored closely during this critical period, it may be possible to take remedial action which will help to avoid, or at least, reduce later problems.

Acknowledgement

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SHOULD WE PROVIDE WATER FOR NEW-BORN PIGLETS?

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Summary

Use of drinking water by very young piglets was determined for 51 litters by weighing and refilling a bowl-type water dispenser each day for the first 4 days after farrowing. Piglets drank an average of 46 g/day per piglet over the 4 days, but there was great variation from litter to litter. Litters that lost weight or gained very little on days 1 and 2 drank a considerable amount of water these days averaging about 110 g/day per piglet on day 2. Litters with high initial weight gains drank little water during this period. Overall, water use, especially on day 2, was correlated negatively with the average weight gain of the litter during the first 2 days ($r = -0.45$, $P<0.001$). The results suggest that piglets will drink appreciable amounts of water on the first days after birth especially if their milk intake is limited. We speculate that under these circumstances, water intake may help to prevent dehydration and promote survival of piglets with low early milk intake.

Introduction

Many textbooks on pig production say nothing at all about provision of water for unweaned piglets, while a few acknowledge that older piglets may use creep feed more effectively if water is available. Despite a few research reports which suggest otherwise, the usual assumption appears to be that a piglet on an all-milk diet has no need for additional fluid.

This assumption is probably true for healthy, rapidly-growing piglets receiving abundant milk from the sow, but not all piglets are so fortunate. Many sows, because of mastitis, hormonal imbalances or other problems, provide milk in reduced or highly variable amounts during the first few days after farrowing. In otherwise healthy litters, piglets that are small or weak at birth may lose weight and die in the first days after farrowing. It is not known whether dehydration, resulting from inadequate milk intake, is a significant problem in piglets that fail to thrive, and whether very young piglets have the developmental maturity to correct dehydration by drinking supplementary water.

In the following study, we recorded the use of supplementary water by piglets in the first few days after birth to determine whether water intake was increased in litters showing signs of low early milk consumption.

Materials and Methods

Daily measurements of piglet water intake were made on 51 Yorkshire litters housed in raised farrowing pens with plastic-coated, expanded metal flooring in a room kept at 20-24°C. Water was accessible to the piglets from the time of farrowing from a plastic drinking bowl with an inverted, 4-L reservoir (Creep Waterer No. 79, Nelson Products Co., Sioux Rapids, Iowa) which was weighed and refilled each day at 10:00-12:00 h for the first 5 days after farrowing. The piglets were also weighed to the nearest 5 g at the same times to give daily weight gains on the first days after farrowing.

All litters were adjusted to 10-12 piglets, usually at the time of the first weighing. Typical daily evaporation from the water dispensers was determined several times, and spillage of water was measured by installing a funnel and collection bottle beneath the water dispenser for 28 of the litters. In 10 litters, the piglets' drinking activity was monitored by time-lapse video recording for 48 h beginning when the litter was first weighed.

Results

Evaporation from the water bowl amounted to only about 2 g/day per piglet, and was ignored in calculating water use. Data on spillage from the drinkers were considered unreliable because urine was almost always found in the spillage bottle, presumably from piglets urinating immediately beside the drinker. Even with the urine, the contents of the spillage bottle accounted for only 20% of water use on average. Because of these complications, total disappearance of water from the dispensers was used as a measure of water use, and the spillage data were ignored. For the 10 litters whose drinking activity was recorded on video tape, water use and drinking activity were highly correlated ($r = 0.95$, $P<0.01$), further supporting the view that most disappearance of water was due to consumption.

The piglets used considerable water during the 4 days of monitoring. Water use averaged 46 g/day per piglet, but varied from less than 10 g/day to more than 200 g/day per piglet depending on the litter. Average weight gain also varied greatly among litters. Some litters gained 200 g or more per piglet each day after farrowing while others lost weight on the first 1 or 2 days and began to gain appreciable amounts only on day 3 or 4. The early weight gain patterns are largely attributed to initial lactation problems experienced by some sows.

Litters with low weight gains tended to drink more water, especially on day 2 (Fig. 1). The relationships involved considerable variation. However, the nine litters with the lowest gains on days 1 and 2 all used >50 g/day of water per piglet on day 2, and the three litters that lost weight on days 1 and 2 all used >100 g/d on day 2.

Differences in early water use by slow-gaining and fast-gaining litters are particularly clear when the 10 litters with the lowest weight gains on days 1 and 2 are compared with the 10 litters which had the highest gains during the same period (Fig. 2). Initially the litters with low gains used much more water than the rapidly-gaining litters ($P<0.02$ on day 2). However, the rapidly-gaining litters showed a steady daily increase in their water use, and by day 4 were using slightly more water, on average, than the litters with low initial gains.

Discussion

The variation in water intake, although large, was far from random. Those litters that gained little or no weight in the first 1 to 3 days after farrowing, presumably because of a temporary inadequacy of the sow's milk supply, were particularly likely to drink water, especially on day 2. On day 1, the litters were just discovering the water source and low milk intake may not have caused much significant dehydration. The high water intake on day 2 was probably in response to low fluid intake on both days 1 and 2. By days 3 and 4 litters with low early weight gain showed reduced water intake (Fig. 2), presumably corresponding to improvements in the sow's milk supply. Interestingly, some rapidly-gaining litters also used appreciable amounts of water. These pigs were probably consuming about 400 g of milk each day; it is

not clear whether the 50-100 g/day of water per piglet used by some of these litters was of any real importance.

The amount of water used by our piglets, although similar to the results of a recent Swedish study, was much higher than reported in several studies from the 1960s and 1970s. We suspect that the extra warmth provided in our modern facilities may account for the difference. Since the 1960s, increased emphasis has been placed on providing very warm conditions for new-born piglets. Well-heated, modern facilities may help to prevent chilling and hypoglycemia in poorly-nourished piglets, but the greater warmth may cause increased water loss from the piglets and thus increase the risk of dehydration in litters that are poorly nourished by the sow, or in piglets with diarrhea, or those that have difficulty competing for milk.

Significance to the Industry

These results lead us to question the common assumption that supplementary water is of no consequence to piglets in the first few days after birth. We would speculate that under-nourished piglets housed in a warm environment may be prone to dehydration in the first days after farrowing, and that at least some such piglets have the developmental maturity to compensate by drinking water. If this proves to be true, then provision of a water bowl accessible to the piglets from birth might help to reduce piglet deaths under warm conditions.

Acknowledgements

We are grateful to Mr. Nick Breedyk, supervisor of the Animal Research Centre pig unit, for drawing our attention to water intake by newborn piglets, and to Mr. R.A. Arcand and the pig unit staff for their cooperation in the study. This paper is based on Canadian Journal of Animal Science 68:603-610, 1988.

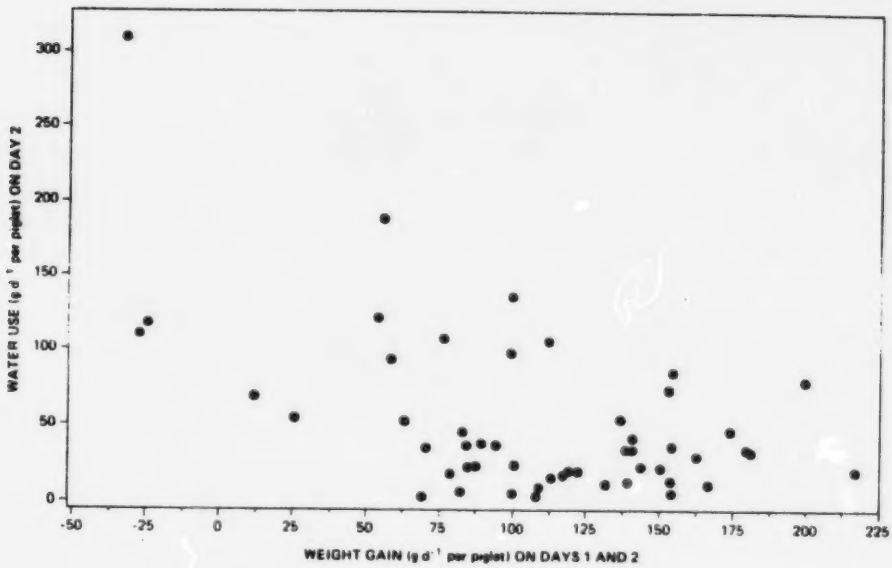

Fig. 1. Average water use on day 2 in relation to average body weight gain on days 1 and 2 for the 51 litters. Each point represents one litter.

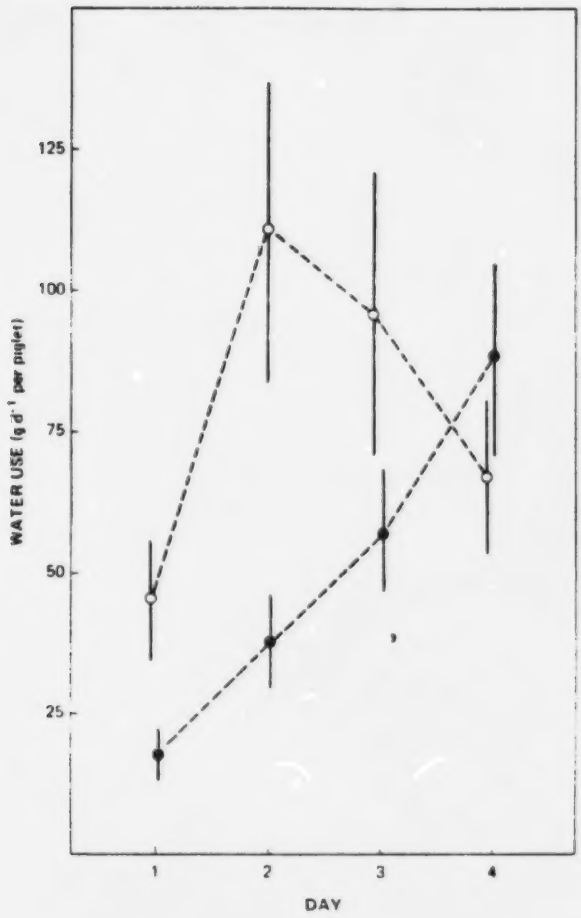

Fig. 2. Average water use on days 1-4 by the 10 litters with the lowest (open circles) and the 10 litters with the highest (closed circles) average body weight gain on days 1 and 2. Litters with poor weight gains on the first 2 days drank significantly more water on day 2 than the rapidly-gaining litters.

Why Do Some Litters of Piglets Have Such Variable Gains?

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INTRODUCTION

"It would simplify management a great deal," wrote Peter English, "if pigs were like 'peas in a pod' at weaning". Unfortunately, experience with pigs is often quite the reverse, with the largest piglets weighing perhaps 3 times more than their smallest litter-mates at weaning time. Part of the problem is caused by the fact that a piglet tends to use the same teat at each suckling episode. If a piglet is too small to keep its teat well stimulated, then the teat will produce less, thus setting up a vicious circle whereby the gap between "haves" and "have nots" becomes larger and larger.

Even so, some litters gain at much more uniform rates than others. The following study was done to identify some of the features that contribute to high and low uniformity in piglet weight gains.

METHODS

An integral part of this work was a comparison of two farrowing crate designs. Our old design was a crate approximately 60 cm (24") wide, whose lowest rail was a straight horizontal bar which tended to interfere with the piglets' access to the teats. As an alternative, we removed this bar from both sides of the crate, and substituted three nearly-vertical prongs or "fingers" which allowed the piglets much better access to the udder.

Two experiments were carried out. The first used 36 litters adjusted by fostering to 8, 10 or 12 piglets. These were the offspring of 18 sows studied in both their first and second lactations. Each sow raised two litters of the same size, one in the horizontal-bar crate and one in the finger crate. Piglets were weighed at birth and 14 days.

The second experiment used 51 litters adjusted to 8-12 piglets at birth. All were the offspring of sows of third or later parity. Litters were assigned at random to horizontal-bar or finger crates. Piglets were weighed at birth, and then weekly to 5 weeks.

RESULTS

Fig. 1 shows three examples that illustrate the type of variation among litter-mates seen over a 5-week lactation. Litter no. 3 had the most uniform 5-week weights of all the litters studied, while litters 48 and 55 had among the least uniform.

Four points emerged from the results.

First, the degree of uniformity among litter-mates at birth had only a slight effect on their uniformity at later ages. In other words the degree of variability changed considerably as the piglets grew, with some litters quite uniform at birth but highly variable by weaning time.

Fig. 2 shows the development of this variability. For each week, the figure shows the piglets' increase in body weight expressed as a percentage of body weight at the start of that week. The figure indicates a great deal of variation developed in the first 2 weeks after birth. In particular, during the first week piglets gained anything from 9 to 180% of their birth weights. In the later weeks, however, piglets tended to gain a fairly fixed percentage of their initial weight. In the fifth week, for example, most piglets gained 30 ± 8% of their 4-week weight, regardless of whether the 4-week weight was 5 kg or 10 kg.

Second, young sows gave more uniform weight gains than older ones. In general, the piglets of a sow's first litter gained at fairly uniform rates. By second parity the gains were more variable, and this variation tended to increase further as the sow aged. This was not simply because of less uniform birth weights. We suspect, rather, that the sow's teats became less uniform (in milk producing capacity) with successive lactations. Perhaps repeated use of certain teats conditions them for greater productivity in the future.

Third, when tested over their first two lactations, some sows gave significantly greater uniformity in piglet weight gains than other sows. Again, this was not due simply to the uniformity of the birth weights. Probably the sows differed in the uniformity of the udder right from their first lactation.

Fourth, the farrowing crates with horizontal lower bars (which interfered with the piglets' access to some of the teats) tended to give less uniform litters than the "finger" crates. The average weight gains were virtually identical in the two crate types; it was the variation around the average that differed. Both experiments showed this effect in the 14-day weights. The effect was less pronounced (and no longer statistically significant) by 35 days in Experiment 2, perhaps because some of the smaller piglets were able to compensate by eating more creep feed.

DISCUSSION

Previous work has shown that competition among litter-mates is an important factor for piglet weight gains. Through some mechanism which is not well understood, high productivity by certain teats appears to cause lower productivity by others. When a farrowing crate blocks certain piglets' access to the udder, it likely reduces their milk intake (and the milk production of their respective teats), thus allowing increased intake by litter-mates with easier access. This could explain why crate design influenced the variability of weight gains without affecting the litter averages.

This finding should not be misconstrued as a blanket criticism of certain crate designs. Whether or not a particular crate interferes with suckling behaviour will depend on the particular dimensions of the crate and of the sows. A crate might suit one herd but not another. The study does, however, suggest a point to watch for: a poorly designed crate may not give lower average weaning weights but may still be contributing to a high degree of variability.

Why all the concern over variability? First, because extreme variation in weaning weight can complicate later management. Second, because very slow-growing piglets are prime candidates for an early grave. In our SPF herd,

many piglets stayed alive to 5 weeks despite very low weight gains; in a more typical herd, they might have been less fortunate.

SIGNIFICANCE TO THE INDUSTRY

For herds producing many litters with highly variable weight gains, this study suggests some places to look for an explanation. Variation in birth weights may not be at fault. Rather, the sows may have inherently variable teat quality, the sows may develop variable teat quality as they age, and a farrowing crate that impedes the piglets' access to the udder may contribute to the problem.

ACKNOWLEDGEMENT

This report is based on Can. J. Anim. Sci. 66:31-46 and 66:361-372 (1986). Figures 1 and 2 are reprinted from these papers.

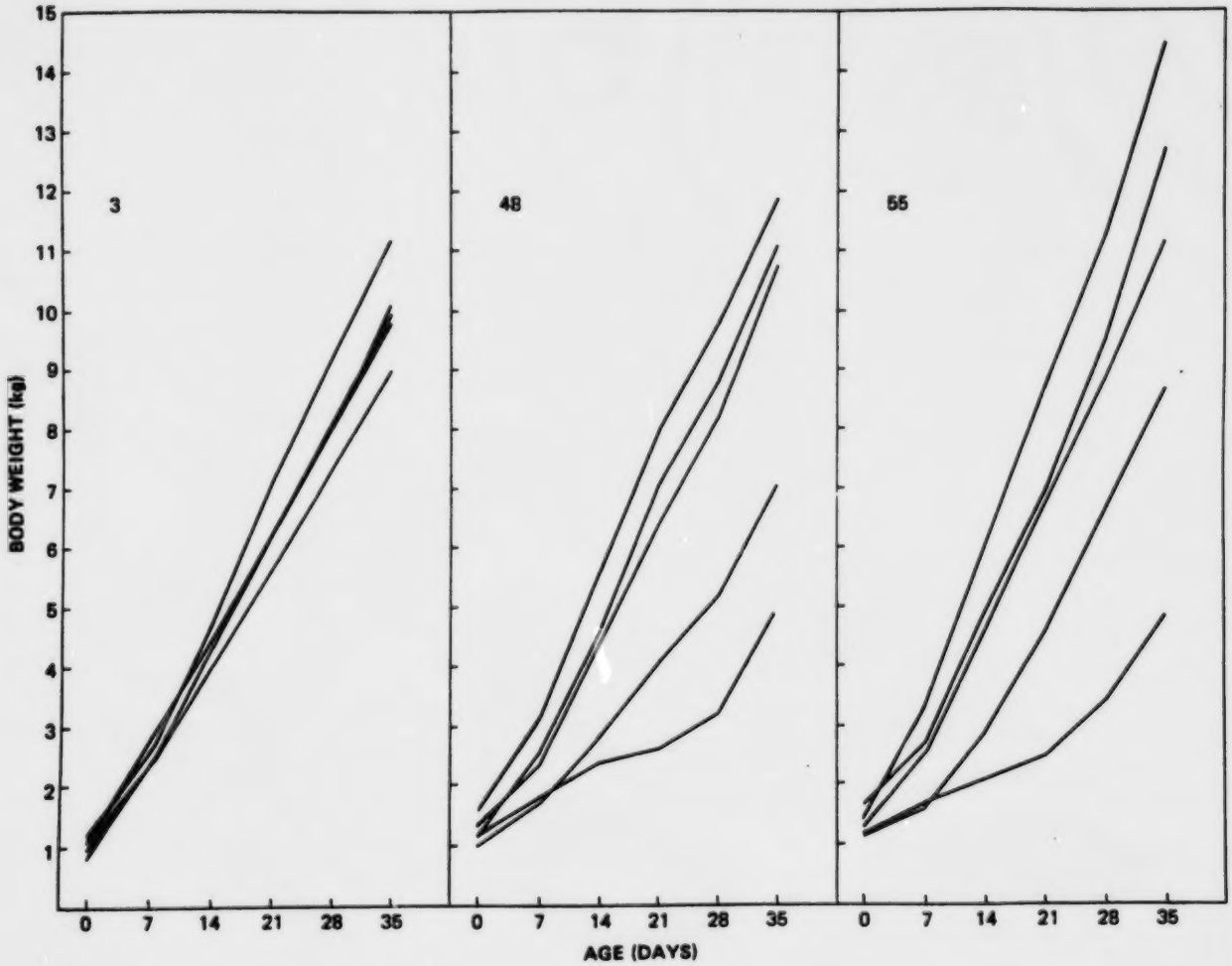

Fig. 1. Examples of very uniform (litter 3, at left) and highly variable (litters 48 and 55) weight gains by litter-mate piglets. In each litter, weights are shown for piglets ranked 1st, 3rd, 5th, 7th and last, based on 35-day weights.

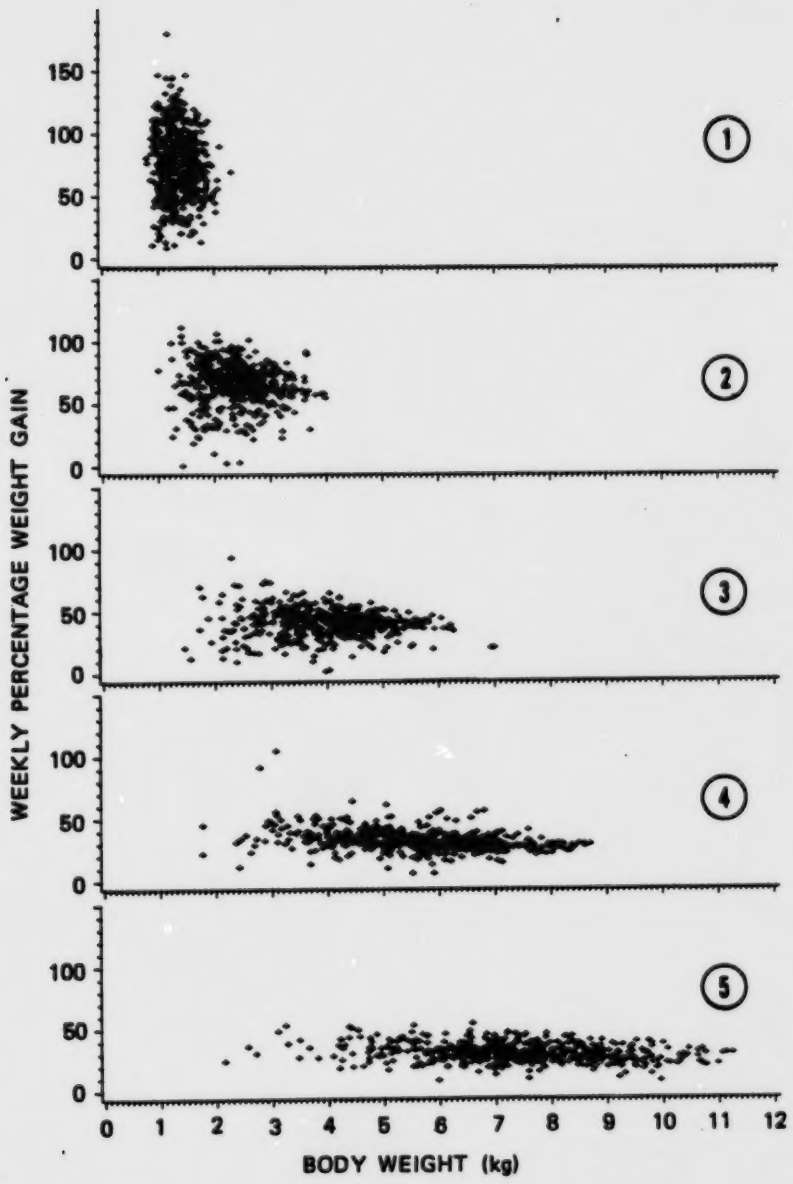

Fig. 2. Weekly weight gain, expressed as a percentage of body weight at the beginning of the week, shown for 488 piglets.

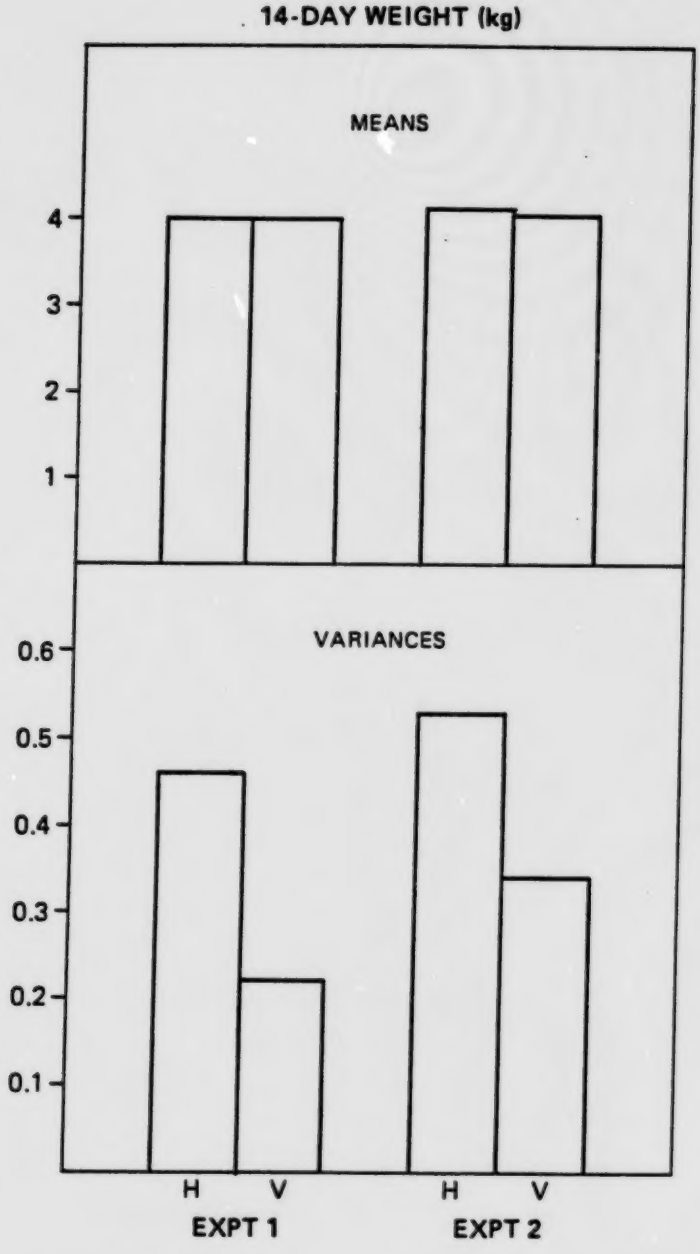

Fig. 3. Mean 14-day weights (above) and within-litter variance in 14-day weights (below) for litters raised with two types of farrowing crates. "H" crates had a low horizontal bar which interfered with the piglets' suckling behaviour. "V" crates had nearly vertical "figures" which allowed better access to the teats. Results from two separate experiments are shown.

SOW NUTRITION

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Gestation

NRC (1988) suggest that a 12% protein diet containing 3.34 Mcal DE/kg and 0.43% lysine is sufficient for gestating sows and gilts. The suggested daily feed requirements range from 1.8 to 2.0 kg feed/day, depending on the weight of the sow and assuming a total weight gain during gestation of 45 kg (25 kg of maternal weight gain plus 20 kg increase in weight due to the products of conception). These recommended feeding levels also assume individual feeding, a corn/soybean-based diet and comfortable environmental conditions. For every 1°C below 19-20°C for individually- housed sows or 14-15°C for group-housed sows, the daily feed requirement must be increased 40 to 60 g/sow, depending on the condition of the sow. An approximate guide to the feeding of a gestating sow is 1% of the sows' weight (kg) plus 0.5 kg of a corn/soybean meal diet or 0.7 kg of a barley/wheat/soybean-based diet. Thus, a 140 kg sow would get 1% of her weight or 1.4 kg, plus 0.5 kg of a corn/soybean meal diet or 0.7 kg of a barley/wheat-based diet, for a total of 1.9 or 2.1 kg per day. It has been suggested that gilts should gain 30 kg body weight in their first parity, 25 kg in their second parity and 20 kg in each subsequent parity. Sows that are overfed during gestation gain too much weight during gestation, lose too much weight in lactation and are generally culled early in life because of feet and leg problems or poor reproductive performance. Underfeeding sows in gestation also leads to high culling rates because of leg weakness and poor reproductive performance. Overfeeding or underfeeding gestating sows does not affect litter size.

Several large-scale studies have reported that increasing sow feed intake in late gestation did increase the birthweight of the pigs by 30 to 50 g (Hillyer and Philips 1980; Cromwell et al. 1989). In general, this increase in birthweight had only a small influence on piglet growth and survival. Therefore, substantial increases in sow feed intake in late gestation are neither warranted nor recommended. However, for sows fed 2 kg or less/d throughout gestation, a 20% increase in feed intake from day 109 of gestation until farrowing will reduce or prevent loss of backfat by the sow and will not significantly reduce feed intake during lactation.

Lactation

The nutrient and energy requirements of the lactating sow will depend on the weight of the sow, her milk yield and its composition and the target change in weight or body condition targeted for the lactation. The NRC (1988) suggest that daily feed intakes of 4.4 to 6.1 kg of a corn/soybean meal diet containing 13% protein and 0.6% lysine will allow the production of average milk yields of 5 to 7 kg/d and minimal loss in sow weight or condition throughout lactation. Sows producing larger milk yields than these will of course require additional feed.

Feed Intake in Lactation

The NRC (1986) suggest that a lactating sow, provided voluntary access to feed containing an adequate supply of nutrients, will consume sufficient nutrients to maintain body weight and support milk production. The average daily feed intake over a 28-day lactation was reported to be 4.27 kg (range 3.76 to 4.80 kg) for gilts, and 4.90 kg (range 4.30 to 6.60 kg) for sows (NRC 1986). These data suggest that many sows consume less

feed during lactation than the levels recommended by NRC (1988). The data of Lynch (1988) support this view (table 1). Approximately 40% of first litter gilts, 50% of second parity sows and 70% or more of third and greater parity sows do not consume the levels of feed recommended by NRC (1988).

In many of these situations, the sow will mobilize her own body reserves, both protein and fat, to maintain milk production (Reese et al. 1982a,b; King and Dunkin 1986; Noblet and Etienne 1986). However, there are obvious limits to the sows ability to mobilize body reserves to maintain milk production. Shields et al. (1985) and Verstegen et al. (1985) have reported that thin sows produce significantly less milk than sows in good body condition. Our data have also demonstrated that underfeeding lactating sows for more than one parity significantly reduces milk yield.

The more the sow eats in lactation, the more milk she will produce, the less weight she will lose and the heavier the litter she will wean. Therefore, the importance of maximizing sow feed intake during lactation is obvious.

Factors Affecting Feed Intake

Among the more important factors affecting feed intake during lactation are appetite, sow feed intake during gestation, farrowing barn temperature and system of feeding.

Appetite

There is some evidence that modern lean-type sows eat less than their counterparts of 20 years ago (ARC 1981). Therefore, traditional systems

of feeding may not be appropriate for such sows. The appetite of the sow is also influenced by her milk yield, which in turn is influenced by the size and vigour of the litter.

Gestation-Lactation Feed Intake Interactions

Feed intake in lactation is greatly influenced by feed intake in gestation, but the reason for this relationship is unknown. It has been demonstrated that the more the sow eats during gestation the less she will eat during lactation (table 2). Therefore, it is important that producers resist the temptation to overfeed sows during gestation. This relationship between gestation and lactation feed intake also exposes a disadvantage of group feeding pregnant sows, in that the more aggressive sows are likely to be overfed.

Barn Temperature

The temperature of the environment has a significant effect on sow feed intake. Lynch (1977) reported that voluntary sow feed intake declined by 12% when the temperature of the farrowing barn increased from 21 to 27°C. The depression in average feed intake amounted to about 0.1 kg/d per 1°C rise in barn temperature above 25°C. Sows with drip coolers consume more feed in hot conditions than control sows. Localized cooling of the head of lactating sows by a jet of cooled air has been shown to increase sow feed intake when barn temperatures exceed 28°C, but not at temperatures between 22 and 28°C (Lynch 1977; Stansbury et al. 1987; McGlone et al. 1988).

Systems of Feeding

It is a common practice for pork producers to gradually increase feed intake of lactating sows over the first three to seven days of lactation. However, many producers now allow sows to feed to appetite immediately after farrowing. The sows are fed three times per day with the major meal in the morning, and have access to fresh feed at all times. On these farms there is no evidence of increased problems with constipation, milk scours, agalactia or sows going off feed. In general, restricted feeding reduces sow feed intake, increases sow weight loss and can increase baby pig mortality by increasing the activity of the sow (English 1970; Stahly et al. 1979; Moser et al. 1987). The objective, therefore, should be to maximize sow feed intake during lactation without upsetting the sow or increasing feed wastage.

Energy Intake

There is ample evidence that energy intakes of less than 12 Mcal DE/d for first-litter gilts increase weight and condition loss, generally reduce pig weaning weights, increase the interval from weaning to estrus, reduce the percentage of sows in estrus within 10 days of weaning and reduce conception rate, embryo survival and subsequent litter size (King et al. 1984; Reese et al. 1982a,b, 1984; King and Williams 1984 a,b; Mullan 1987; King and Dunkin 1986). The effects of restricted energy intake are less obvious in multiparous sows (Reese et al. 1982; Mullan 1987a,b), at least for one parity, but continued underfeeding of a lactating sow will increase weight loss, decrease milk production and delay return to estrus. These data emphasize the importance of ensuring an adequate energy intake by lactating gilts and sows.

The mechanism by which the loss of weight or condition loss during lactation affects sow reproduction is unknown. It appears likely that the amount of body reserves at farrowing and weaning are the critical factors affecting sow reproductive performance, rather than the amount of tissue mobilized during lactation. Thus, a small weight loss in a thin sow may be more serious than a large weight loss in a well-conditioned sow (Esbenshade et al. 1986).

Postweaning

The major objectives of nutrition during the postweaning period are to shorten the interval to effective service, to synchronize the onset of estrus and to maximize ovulation and conception rates.

Increasing the level of feed postweaning has been reported to shorten the interval to service in primiparous sows (Brooks and Cole 1971; King and Williams 1984a) and to increase the number of such sows exhibiting estrus within 10 days of weaning (Brooks and Cole 1971; Fahmy and Dufour 1976; den Hartog and van der Steen 1981; Tribble and Orr 1982). It is possible that gilts respond differently to postweaning feed intake than do multiparous sows (Brooks and Cole 1971). It appears that gilts or sows that have lost excessive weight or body condition during lactation will respond to high levels of feed during the postweaning period. The postweaning performance of sows in good body condition is not influenced by level of feeding after weaning.

It is concluded that level of feeding in the remating interval is unlikely to improve reproductive performance except where it reverses a reduction in performance due to poor nutrition management in lactation (Pike and Boaz 1972).

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Table 1. Variation in feed intake during lactation of sows fed to appetite.

	Parity			
Feed/d (kg)[a]	1	2	3	4
	% Sows			
< 3.0	8	1	3	4
3.1 - 4.0	32	7	4	4
4.1 - 5.0	45	43	32	28
5.1 - 6.0	15	41	52	54
> 6.0	0	8	9	13
Mean feed/d (kg)	4.2	5.0	5.1	5.3

Lynch (1988).
[a]Barley-wheat based diets containing 3.0 Mcal DE/kg.

Table 2. Effect of feed intake and weight gain during gestation on feed intake and weight loss in lactation.

	High	Medium	Low
Gestation			
Feed/d (kg)	2.64	2.0	1.5
Wt. gain (kg)	67	48	30
Lactation			
Feed/d (kg)	3.40	4.46	4.90
Wt. loss (kg)	30.7	15.8	3.6

Mullan (1987).

ENVIRONMENTS TO ENHANCE FARROWING BARN PERFORMANCE

by
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Woodstock, Ontario
February 1989

The typical farrowing room environment is a compromise. On the one hand, we have a mature sow that prefers a room temperature of about 18 °C. This room also houses the newly born piglet that requires a temperature of between 32 and 34 °C. Obviously an older piglet just about ready to be weaned will require a temperature of 24 or 25°C. The compromise is the fact that we keep this room at about 21 °C. This particular temperature is not desired by any of the animals housed in this environment. However, all is not lost. Farrowing rooms kept at this temperature do work quite well. The sows seem to be able to tolerate this warmer temperature and the use of radiant heat along with creep areas allow a warmer microclimate to be established for the small piglets. How can we improve this environment to enhance pig performance?

One of the major improvements that I have noted in recent years is the use of air inlet systems that provide a low air speed at pen level but still are able to provide good air distribution throughout the room. There have been a number of developments in this area. One of the most widely used is the concept of providing an air recirculation duct below the fresh air inlet. Not only does this provide a blanket of warm room air to carry and mix the incoming fresh air, but it also maintains a consistent air distribution pattern throughout the year. Our knowledge of air jets and distance of throw from particular sized holes has dramatically reduced air speeds at the pen level.

The use of the intermittent self-adjusting air inlets have dramatically improved both the control and distribution of fresh air along the length of the room. In many rooms with a double row of farrowing crates head-to-head a two foot long self-adjusting air inlet per crate can provide good control of air flow and excellent distribution without the aid of recirculation.

Recently, two new types of air inlets have been introduced to Ontario from Europe. Both of these inlet systems promote low air inlet velocity and yet claim very good air distribution throughout the room volume. My experience with these systems to date has verified their claims.

The EVEN-FLOW from Holland is essentially a version of a porous ceiling. They employ stainless steel strips with numerous small holes along their lengths. These metal strips are generally spaced every two feet across a false ceiling of polystyrene such that fresh air from a preheat hallway is directed into the space between the two ceiling surfaces and then allowed down into the room through the metal strips. This porous ceiling concept is not new and has certainly proven itself in many cases to be a very workable system with very low air speeds at pen level.

A ventilation company from Denmark called FUNKI has recently introduced a line of ventilation equipment to Ontario. They offer a large diameter air inlet sock made from a paper filter material. This inlet duct is simply suspended from the ceiling and connected to a preheated hallway via a simple connecting ring. This duct has no fan associated with it. The incoming air simply filters through the porous air tube as the exhaust fan removes air from the room. Again we have an air inlet that provides for very low air inlet velocity and yet very uniform air distribution along the length of the room. **Please remember that both of these systems**

do require a preheat hallway when used for farrowing or weanling facilities.

A second way that we have enhanced farrowing barn performance is with more effective use of supplemental heat. The use of the air recirculation duct for also distributing heat from a unit heater has been very effective. Coupled with this is the vast improvement in temperature control that has been achieved by having these unit heaters operated by a line voltage thermostat located in the room beside the ventilating fan thermostat such that both systems are monitoring the same temperature. A recent development from Chromalox is an electronic heat controller. This controller was originally developed for residential baseboard heat and has proved very successful. They are now looking at other markets for this controller. This 24 volt controller compares the actual room temperature with the desired set-point temperature every twelve seconds and depending on how far from set-point the actual temperature is then the heater will be activated for a portion of the next twelve second period. This frequency of monitoring room temperature means that this devise can very accurately control room temperature. It also means that it can make a large heater act like a small heater if in fact that is all that is required. Every barn ends up with an oversized heater come spring and fall weather conditions. This controller may be able to eliminate this heater sizing problem that we designers have. A number of producers has installed this Chromalox TC-900 electronic thermostat and are achieving very good temperature control with it. However, it is a household thermostat, 24 volt and not suited to the harsh environment to which we are exposing it. Many of these controls have been replaced within the first year to year and a half. We are working with Chromalox in an on-farm evaluation of this controller compared to a typical line voltage control and the results to date are very encouraging. I am hopeful that by the end of this year we will see a unit heater package offered by

Chromalox that will include the heater and this controller packaged in a NEMA rated electrical box such that it will be suited to typical livestock buildings.

We also can utilize spot heat (radiant heat) more effectively in the farrowing room to enhance pig performance. Unfortunately, we still find some producers using a heat lamp in a crate with total perforated flooring. Not only is this inefficient from the standpoint of the rays of heat penetrating through the slotted floor to the surface of the manure, but we establish an undesirable convection current from the pit area back up into the farrowing pen. Radiant heat should always be used in conjunction with a solid floor section. Some producers are even using heat mats in combination with heat lamps to enhance that microclimate in the creep area. The use of dimmer switches and diode switches on our heat lamps has also improved the comfort level in the creep areas during spring and fall conditions.

What about sow comfort and performance in warm summer weather? In southern Ontario the last two summers have included more than 30 days when the outside temperature has exceeded 30°C. Sow performance is definitely affected. These sows are heat stressed; they pant; they do not eat as much; and they do not milk as well. Drip cooling for sows in crates is a very simple system that we are starting to see on farms. Several years ago Kansas State University studied drip cooling of lactating sows and found the following improvements:

1. A lower respiration rate -- 29 versus 64 breaths per minute. It is interesting to note that a respiration rate greater than 50 breaths per minute is considered heat stress.

2. A one kilogram higher daily sow feed intake was observed with cool sows. That amounts to 20 percent more feed intake than the control group that was not drip cooled.

3. The average sow weight loss during lactation was 14 kg. less with the drip-cooled sows.

4. The total litter weight at weaning was 5 kg. higher with the drip-cooled sows. That amounts to a 10 percent higher litter weight. This would indicate that these sows milked better during their lactation.

Several commercial companies offer drip-cooling systems along with automated controllers to activate on temperature. These systems are simple to install and seem to be very effective. Their disadvantage is that they do add water to the manure system and can make a partially slatted farrowing crate quite wet. The water is directed to the shoulder and neck area of the sow but should not be allowed to get into the ear as this is very irritating.

Certainly, there are other types of cooling systems that can be considered. A few people have tried zone cooling with air ducts and some producers have evaporative cooling systems that use the pad and fan principle. All are effective.

In the preceding paragraphs I have discussed a few environmental factors that can enhance performance in the farrowing barn.

COMMON PERFORMANCE BARRIERS IN FARROWING AND NURSERY FACILITIES

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Ontario Ministry of Agriculture and Food,
Guelph, Ontario

For presentation at the 1989 Manitoba Swine Seminar,
February 22, 1989.

Great strides have been made in the last decade in the performance of the swine herd in both the farrowing and weanling areas. Pigs reared per sow have increased on many farms from 14 pigs per sow to over 20 with a reduction in age at market of 10 to 20 days. The following are some of the changes we see being made in Ontario which contribute to these improvements.

FARROWING FACILITIES

Full Slatted Floors

For many years the partially slatted floor cantilevered over a shallow gutter was the most popular farrowing room floor. Part of the reason for its popularity was that much of our sow herd in the province was housed in old barns. This was an easy technique to get a liquid manure system for the farrowing crates especially in the second floor, since it did not require deep gutters.

Further, there was resistance to a fully slatted floor for fear of drafts through the flooring and higher gas levels.

However, as time went by, it became increasingly difficult to get them clean due to the pitting of the solid floors. The pathogens left led to a continual battle against enteric diseases.

Consequently, the initial reluctance towards full slatted floors has been replaced with a general enthusiasm for them. Increases of up to a pig per sow weaned per litter are not uncommon.

Drafts

The full slatted floors are often 16" deep pits built above the the floor. Others, however, are simply raising the crates on legs. In this case drafts can be a real problem and special provisions to cut the air speed through the floor with skirting around the bottom of the pen is often necessary. Some temporary solid floor such as rubber belting also helped. Heat mats are popular but not always standing up. Some of the European farrowing pens have introduced hot water floor heating in a crate which works well.

For existing farrowing pens, hovers have reduced the air speed around the pigs. Even a simple piece of plywood set across the top of the creep partitions can help immeasurably.

The use of smoke pencils to identify these drafts have been a great tool to show the operator the nature of the air movement and how effective hovers or floor mats can be.

Heat Bulb Management

More attention is being given to heat bulb placement during and after farrowing. Peter English's work has shown that hanging a heat bulb at the back of a sow during farrowing can reduce chilling of the new born pigs and reduce preweaning mortality. Further reductions can be made by placing heat lamps on either side of the sow's udder for 48 hours after weaning, since new born pigs have a strong instinct to stay at the udder. This simple management technique has helped to save many pigs.

Waterers and Feeders

In partially slatted farrowing pens the waterers were too often installed too high. The sow took water into her mouth, which as often as not overflowed, running down her jowls to wet the front of the farrowing pen floor. Consequently farmers did not want a high flow rate in these nipple drinkers for fear of aggravating the problem.

Moving the drinkers down into the trough can eliminate much of the problem. With the sow's head now pointed down, spillage from her mouth runs into the trough. The flow rate no longer needs to be restricted, leading to increased water consumption and better milking.

NURSERIES

Nursery facilities used to be part of the farrowing rooms and often involved large pens with partial slatted floors and open pen partitions. It was not fully appreciated the stress these pigs were under. A better, more precise environment was needed.

Kennels

A simple approach is to create a micro climate within the room which the newly weaned pigs would find acceptable. This can be done with the use of some sort of kennel arrangement where the sides, front, floor and top of part of the pen is closed. A strip curtain is used to separate the kennel from the dunging area. The temperature in the kennel is raised significantly and the drafts almost eliminated.

This approach has not been widely adopted in Ontario. It has the compromise of housing the newly weaned pigs in the same room as the farrowing sows. More of problem is the extra management involved in fine tuning the temperature in the kennel. The need for heat falls rapidly as the appetite of the weanlings in-

creases. Not adjusting the curtain or lid will lead to dunging in the sleeping area. For those prepared to put the management into it, it is an inexpensive approach to improving weanling comfort.

Hot Nurseries

A more popular alternative has been the addition of specialized hot nurseries. Double-deck cages were often used which incorporated fully slatted floors for cleanliness, small numbers of pigs per pen to reduce competition, and shallow feed troughs for freshness of feed.

These rooms performed better than the existing facilities. A higher room temperature is the single major advantage providing an environment within the pigs' comfort zone.

There are compromises with such a system. The rooms are continuous flow thus never are completely cleaned out. Further, room temperature can never be correct for all the pigs. If the room temperature is cool the new arrivals will be chilled. If the room temperature is warm it may reduce feed intake in the older pigs.

All-in/All-out Nurseries

The ideal is the all-in/all-out nursery where pigs are put in at 3 or 4 weeks of age and stay in the same room until they are 9 to 10 weeks of age. Such a facility can be fully cleaned out between crops and the temperature can be precisely tuned to the needs of all the pigs.

These rooms are more expensive since enough space is being provided for pigs at 10 weeks of age. When 4 week old weanlings are put into these pens they look excessive. Time and labour for moving pigs and washing is saved. This along with improved performance and reduced health problems is used to justify this system.

Case Studies

The attached case study illustrates two examples of farmers wishing to improve their weanling facilities at modest cost. It shows that there are a number of alternatives that have to be considered, and that each has its own advantages and disadvantages.

CASE STUDY: ONE ROOM WEANLING

Franklin Kains, OPIIP, Guelph

FARROWING ROOM:

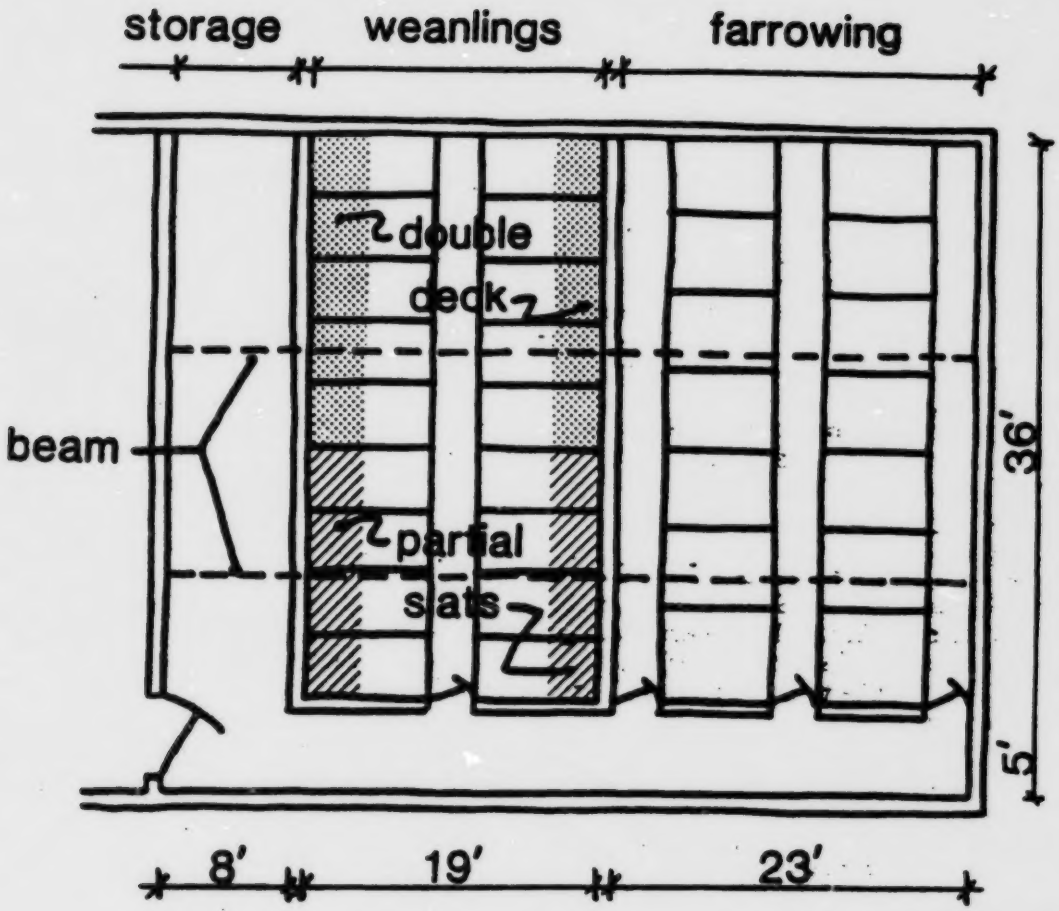
- 14 sows/room
- ventilation:
  min. 20 cfm x 14 = 280 cfm
  max. 300 cfm x 14 = 4200 cfm
- ventilation through joists up to 1000 cfm
- each joist approximately 90 sq. inches good for 300 cfm
- joist should be able to supply 2000 cfm
- drill 4 holes/ft. in each of the 6 joist ducts
- total approximately 840 holes
- close off 3 joists in cold weather, especially if there is any indication of uneven introduction of air (one end colder than the other)
- install static pressure gauge in room to check static pressure
- should be less than 0.10" water pressure

HOT NURSERY:

- room approximately 36' x 6'3"
- one row of 9 - 4'x4' decks along west wall of room
- partitions between pens solid plastic for ease of cleaning, to reduce water spray while cleaning and reduce drafts
- air inlet is same principle as peg board, but use plywood for durability
- drill 650 - 3/8" diameter holes evenly spaced over plywood
- close off joists over pens in winter as needed to reduce cold drafts on pigs
- minimum ventilation - 200 cfm (examples: 8" Multifan, 6 1/2" AAA MiniBrute, 8" CanAm)
- additional fan capacity, variable speed delivering 2000 cfm (14") with variable speed controller
- 5 kw heater located in service hallway directed towards open ends of joist

- remote thermostat for heater:
  Chromalox external sensor - 14712
  Chromalox thermostat (locate in hall) - TC900R
  Chromalox power module PM2

- fan of heater must be wired to run continuously
- locate thermostat beside fan thermostats and set 3C° lower
- all thermostats should be set as low as possible above the pigs



CASE STUDY: ONE ROOM WEANLING

CASE STUDY: CONTINUOUS FLOW NURSERY

Franklin Kains, OPIIP, Guelph

HOT NURSERY ROOM

Option 1:

split room lengthwise into two rooms, each containing 2 weeks production of approximately 140 pigs

- pigs could be brought in weekly or biweekly depending on farrowing schedule
- if brought in weekly, half the pigs would stay for 3 weeks, the other half for 4 weeks after which the room is emptied, washed and refilled
- one half of one room will be empty for half the time (this represents one eight of the floor space over time will sit idle to be able to practice all-in/all-out)
- present pit wall along north side of feed passage will have to be moved to the north about 2' to allow for an alley in both rooms
- ventilation with exhaust fans out west wall with potential to use the heat exhanger for minimum ventilation for both rooms
- with an outside wall in both rooms a window can be retained in both rooms
- air inlet from 4'x 4' plenum built into attic existing feed alley with self adjusting inlet along length of room
- requires 4 - 2' long inlet units per room evenly spaced down length of room
- minimum ventilation of 150 cfm per room, 300 for two rooms put through heat exhanger
- maximum ventilation rate of an additional 4000 cfm per room

Option 2:

split existing area into 2 rooms across the middle of the room again with 2 weeks production per room

- similar to above except the wall of the existing gutter need not be moved; thus less construction and less loss of floor space (approx. 64 sq. ft. usable pen space saved
- same arrangement for flow of pigs and scheduling of weaning sows
- minimum exhaust via a duct Room 1 to Room 2 to outside;
- exhaust fan to handle 280 x 2 = 560 cfm (example Del Air 8" fan)
- additional exhaust of 3900 cfm via 18" or 20" variable speed fan in each room
- fan in Room 1 must go up through ceiling (example from Tri Bar Flooring, Mitchell)

Option 3:

split room crosswise into 4 rooms, each containing 1 week production of approximately 70 pigs

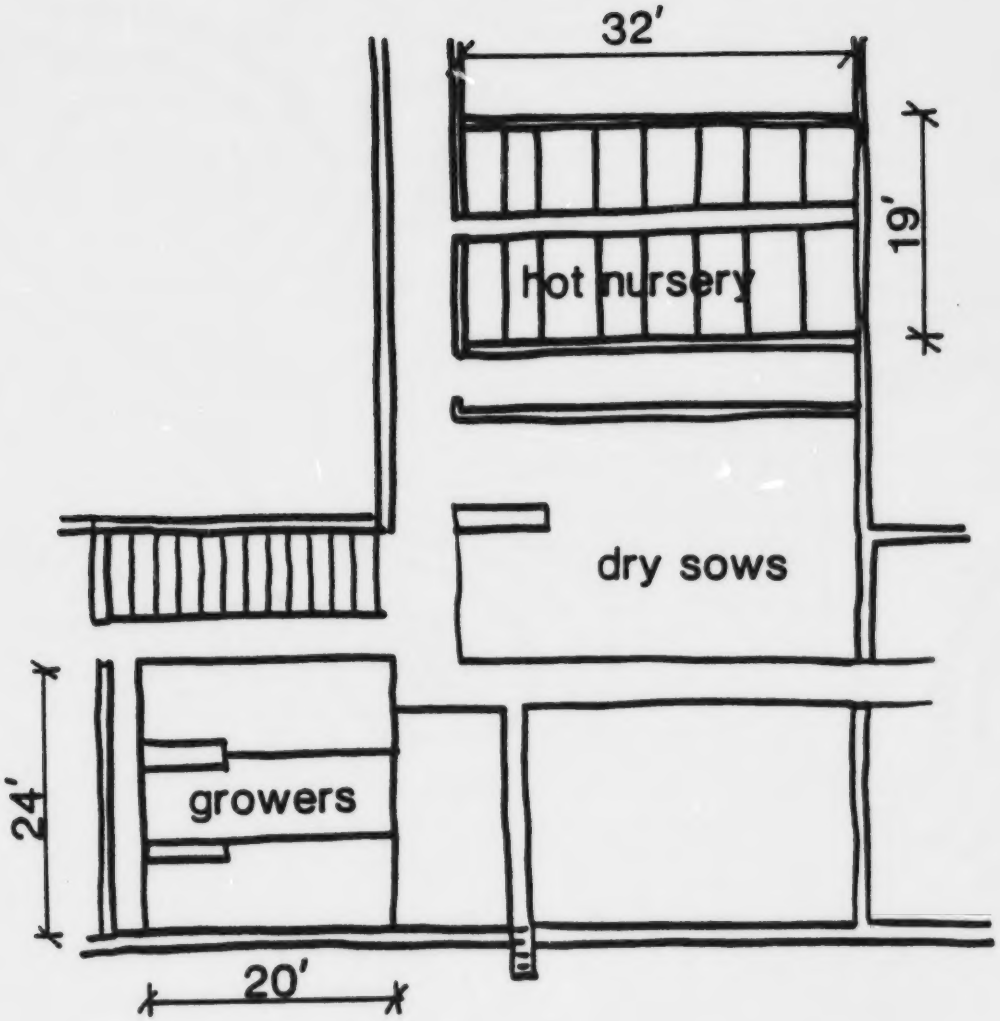
- all rooms all-in/all-out on a weekly basis
- all pigs stay for 4 weeks less one day for clean-up
- ventilation rates half of other options
- 3 rooms would require ceiling exhaust for summer fans of approximately 1800 CFM capacity (14" - 16")

Air Inlet:

- all options require an attic duct to supply summer air
- attic duct as per CROSS ATTIC DUCT leaflet is slightly under-sized since we need about 8000 cfm total; increase height to 6' from 4' should be reasonably easy construction
- need an opening from hallway to this duct of 16 square feet
- one 4' long self adjusting inlet unit per 8' of room will be satisfactory
- electric heat can be used at entrance of duct to pre-heat the air going to rooms

GROWER AREA:

- existing pens to be split in half to create 6 pens
- make 2 additional pens next to loading chute
- each pen approximately 8' x 10' and will hold 18 pigs
- 4 pens will hold 1 week production
- pigs will stay in this grower area for 2 weeks and be approximately 9 weeks of age when they leave
- ventilation for area for 140 pigs:
  min 140 x 5 = 560 cfm
  max 140 x 50 = 7000 cfm
- fans - 2 speed 12" fan, 7 speed 18", 1 speed 18"
- air inlet from attic with a 2' long self adjusting inlet along back to back partition

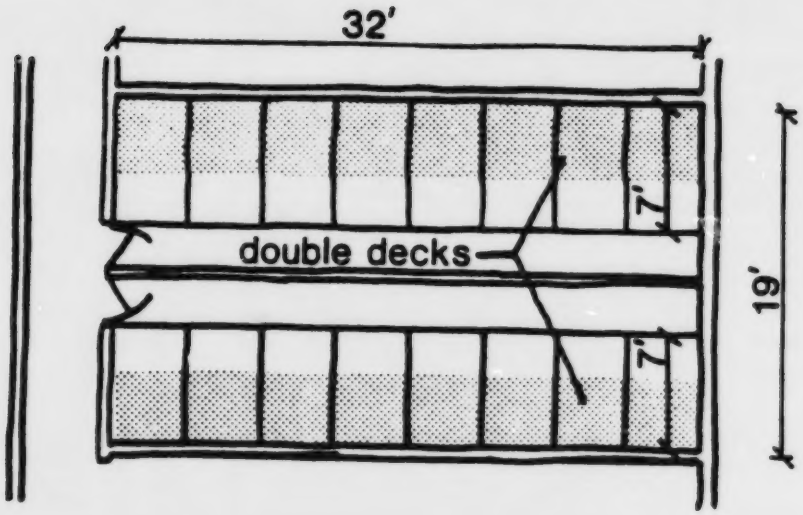


CASE STUDY: CONTINUOUS FLOW NURSERY

OPTION 1

2 ROOMS

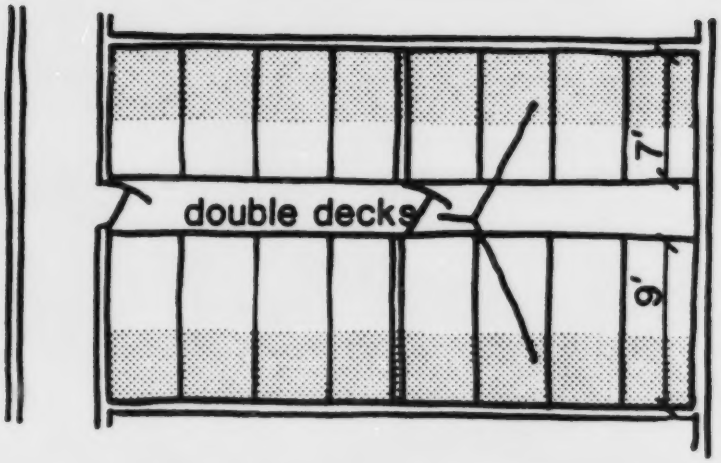
LONG SPLIT



OPTION 2

2 ROOMS

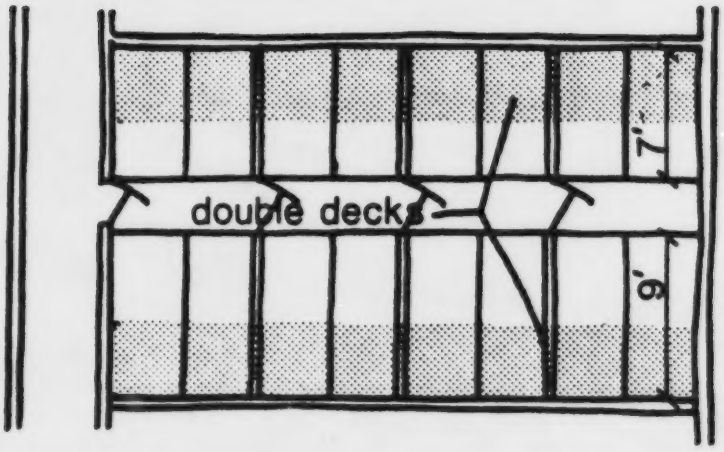
CROSS SPLIT

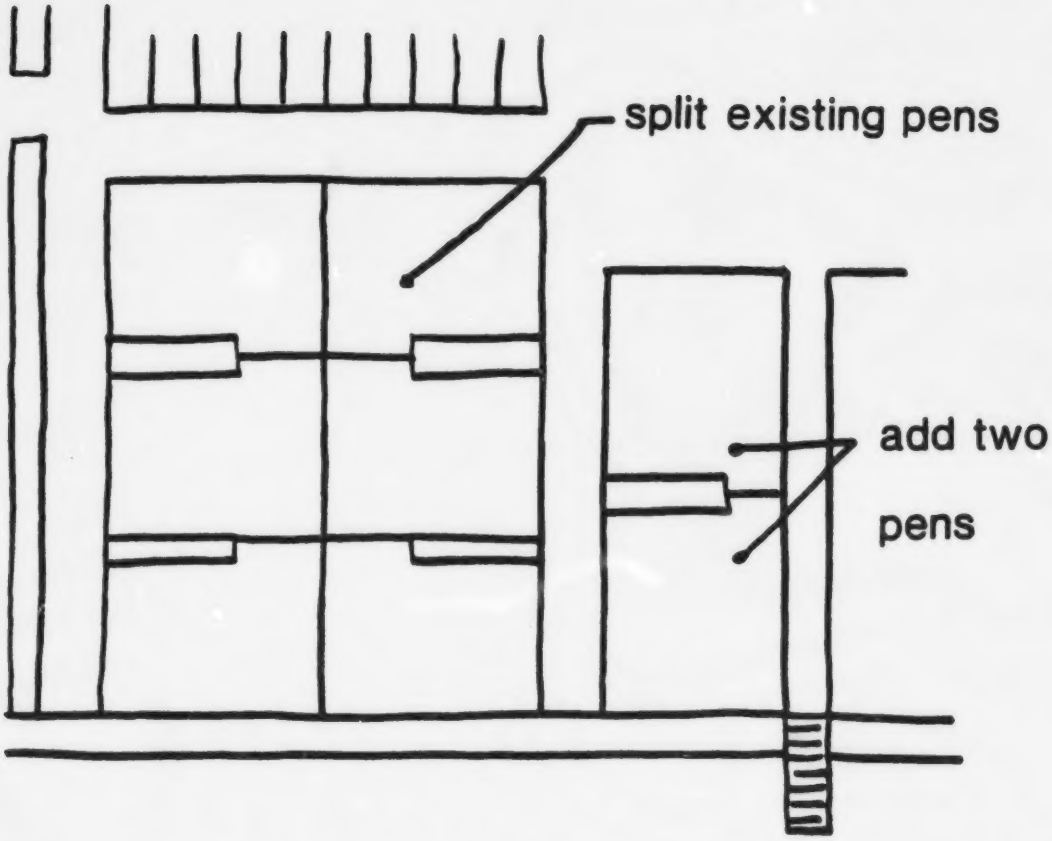


OPTION 3

4 ROOMS

CROSS SPLIT





GROWER AREA CHANGES

Tail Biting: A Few Ruminations

Dr. David Fraser

The following two articles cover most of the points raised by Dr. Fraser in his presentation. People wishing a complete review of his presentation should request a copy of the videotape available from the people listed in the front of these proceedings.

Mineral-deficient Diets and the Pig's Attraction to Blood: Implications For Tail-biting

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SUMMARY

Individually-penned growing pigs were presented daily with two "tail models" (lengths of cotton cord about the size of a pig's tail), one of which had been impregnated with pigs' blood. Pigs that were fed a diet lacking all mineral supplements (iodized salt, dicalcium phosphate, limestone, iron, zinc, manganese, copper, and selenium) had a pronounced increase in chewing the blood-covered model, and 4 weeks of recovery on a balanced diet reduced, but did not completely eliminate, the enhanced attraction to blood. In a second experiment, a similar heightened response to blood was produced by omitting only iodized salt from the diet, whereas omission of all other mineral supplements led to a much smaller and statistically non-significant change. Although the causes of tail-biting are undoubtedly complex, the results suggest that heightened appetite for salt could make pigs particularly attracted to pen-mates with injured tails.

INTRODUCTION

A growing pig will seldom quail
From chewing on his neighbor's tail.
At first, this unendearing act
Arises simply from the fact
That pigs by nature root and chew
When they have nothing else to do;
But thus engaged, a pig may find
That neighbors, bitten from behind,
Secrete a red liqueur whose flavor
Many swine appear to savor:
At first a nip, and next a swallow,
Then nastier results may follow.

This hypothesis on the development of tail-biting has emerged (albeit in prose) from a number of sources. A Dutch worker first argued that tail-biting is usually derived not from fighting, but from the quiet exploratory chewing that pigs in an environment of low complexity often direct at their pen-mates. Other observers have noticed that tail-biting can escalate suddenly once a bleeding wound develops, probably because the animals are attracted by the taste of blood. But are there dietary factors that increase this attraction?

Surveys and anecdotal reports have often implicated dietary mineral deficiencies or imbalances as likely contributing factors in

tail-biting outbreaks. Iron, copper, calcium, phosphorus, and salt (NaCl) are often mentioned. Although pigs require only about 0.2% NaCl in the diet for maximum weight gain, NaCl is often provided at 0.5% of the diet for growing pigs, and it is sometimes suggested that an increase to 0.75 or 1% can reduce the incidence of tail-biting.

In the following experiments, pigs were exposed to simple "tail models" -- lengths of cotton cord about the size of a pig's tail -- which could be impregnated with blood. The models were used to study whether mineral deficiencies in the diet can cause increased attraction to a source of blood.

MATERIALS AND METHODS

Two experiments used 48 Yorkshire pigs aged about 10 weeks and penned individually. The pigs' degree of attraction to blood was tested by the use of "tail models" consisting of sections of unwaxed white cotton sash cord 18 cm long and 1.3 cm in diameter. Two such tail models were attached to the gate of each animal's pen for 24 min each day, 5 days per week in each week of testing. An observer recorded the amount of time the pigs spent chewing the models. One model was plain, and the other had been soaked overnight in fresh, whole, pig's blood and allowed to dry in the air for at least 24 h. The standard diet (used for all pigs before the experiment began, and as the control diet) included 51% corn, 25% barley, 17% soybean meal (at 48% crude protein), 2% Tallow, 1.5% Lignosol, and the following mineral ingredients: 1.0% dicalcium phosphate (18% Ca, 20% P), 1.0% limestone (38% Ca), 0.5% iodized salt, and 0.5% trace mineral pre-mix which supplied, per kilogram of diet, 80 mg iron, 50 mg zinc, 20 mg manganese, 6 mg copper, and 0.1 mg selenium.

Experiment 1

The first experiment used 16 pigs and compared the control diet with a diet from which all mineral supplements had been omitted. The experiment lasted 9 weeks, with observations made in each of weeks 1, 3, 5, 7, and 9. During week 1, all pigs remained on the control diet. During weeks 2 to 5, half the pigs received the mineral-deficient diet, and were then returned to the control diet for weeks 6-9. The other pigs continued to receive the control diet throughout, with observations made at the same time as the experimental animals.

Experiment 2

The second experiment used 32 pigs and four diets: (1) the control diet from Experiment 1, (2) the mineral-deficient diet from Experiment 1, (3) a salt-deficient diet, the same as the control diet but lacking the 0.5% iodized NaCl, and (4) a "salt only" diet, lacking the other mineral supplements (dicalcium phosphate, limestone, and trace mineral pre-mix) but with iodized NaCl present at 0.5%.

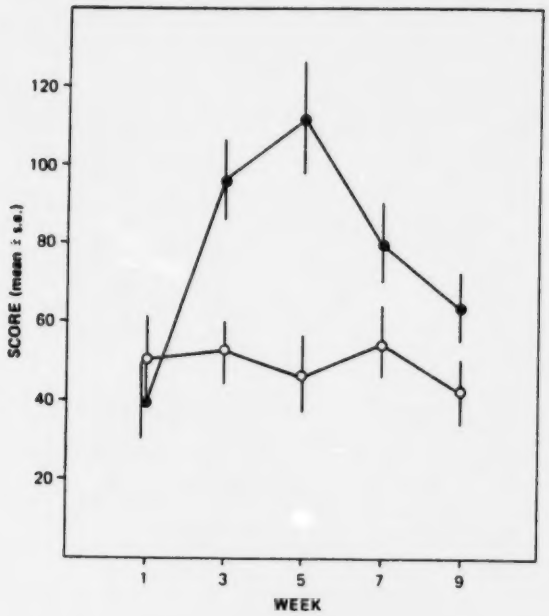

Fig. 1. Mean score per day for chewing the blood-covered model in exp. 1. Eight pigs (dark circles) were fed the control diet in week 1, the mineral-deficient diet in weeks 2–5, and the control diet in weeks 6–9. Eight matched control pigs (open circles) received the control diet throughout. The score is defined as the number of instantaneous observations (maximum of 240) in which the pig was chewing on the blood-covered model.

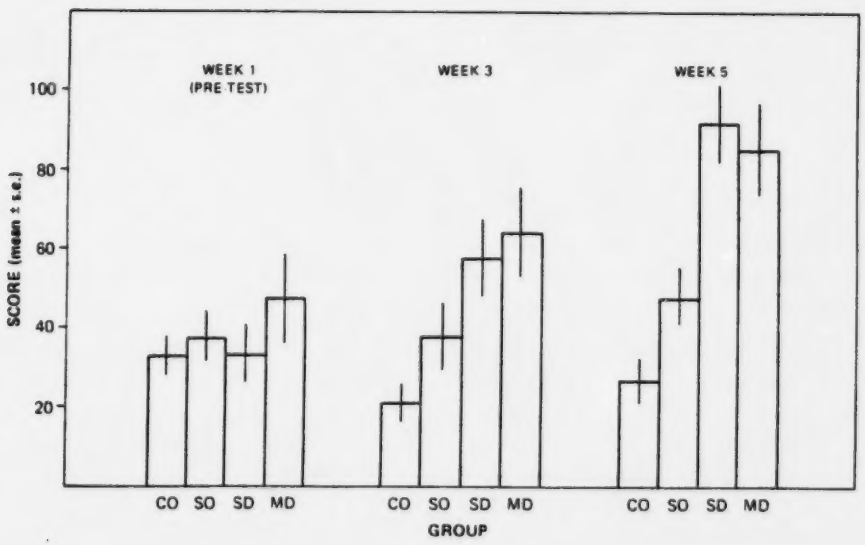

Fig. 2. Mean score per day for chewing the blood-covered model in exp. 2. All pigs received the control diet in week 1. Thereafter, group CO continued to receive the control diet, group SO received the salt-only diet, group SD received the salt-deficient diet, and group MD received the mineral-deficient diet.

The experimental period lasted 5 weeks, with observations made in weeks 1, 3, and 5. All pigs received the control diet until the end of week 1. Then 8 pigs were assigned to each of the four diets for weeks 2-5.

RESULTS

Experiment 1

When changed to the mineral-deficient diet during weeks 2 to 5, the eight pigs showed a pronounced increase in chewing on the blood-covered tail model (Fig. 1). When returned to the control diet in weeks 6 to 9, the amount of chewing decreased, but remained somewhat higher than that shown by the eight pigs fed the control diet throughout.

Experiment 2

In week 3, during their second week on the experimental diets, the amount of chewing on the blood-impregnated models had already begun to differ between the four diet groups ($P<0.02$). In week 5, the pigs on the mineral-deficient diet and the salt-deficient diet chewed the blood-impregnated tail more than the pigs on the other two diets (Fig. 2). Statistical analysis showed that the pigs on the mineral-deficient and salt-deficient diets scored significantly higher than the pigs on the other two diets, while no other comparisons reached the 5% level of significance.

DISCUSSION

In both experiments, omission from the diet of all mineral supplements was followed by a striking increase in the pigs' attraction to blood. In Experiment 2 an equivalent effect was achieved by providing a diet lacking iodized NaCl alone. If NaCl was present in the diet, then omission of all other mineral supplements had a smaller and statistically non-significant effect. There is, however, room for further work to determine whether long-term mineral deficiences other than NaCl can eventually produce heightened attraction to blood.

Compared to the diets offered, blood contains a high concentration of sodium, chloride, iron, and selenium but not of the other major mineral nutrients. The attraction to blood evoked by the mineral-deficient diets was most likely due in large part to the well-known sodium appetite that develops under conditions of low sodium intake.

These results also have implications for the widely-recognized role of "stress" in causing this behavioral problem. In sheep, rabbits, and rats, high levels of the stress-related hormone ACTH in the blood lead to a marked increase in sodium appetite. In these species, stressors such as cold, crowding, and physical restraint, which tend to cause higher output of ACTH, are presumably capable of causing heightened attraction to sodium. If the pig follows this

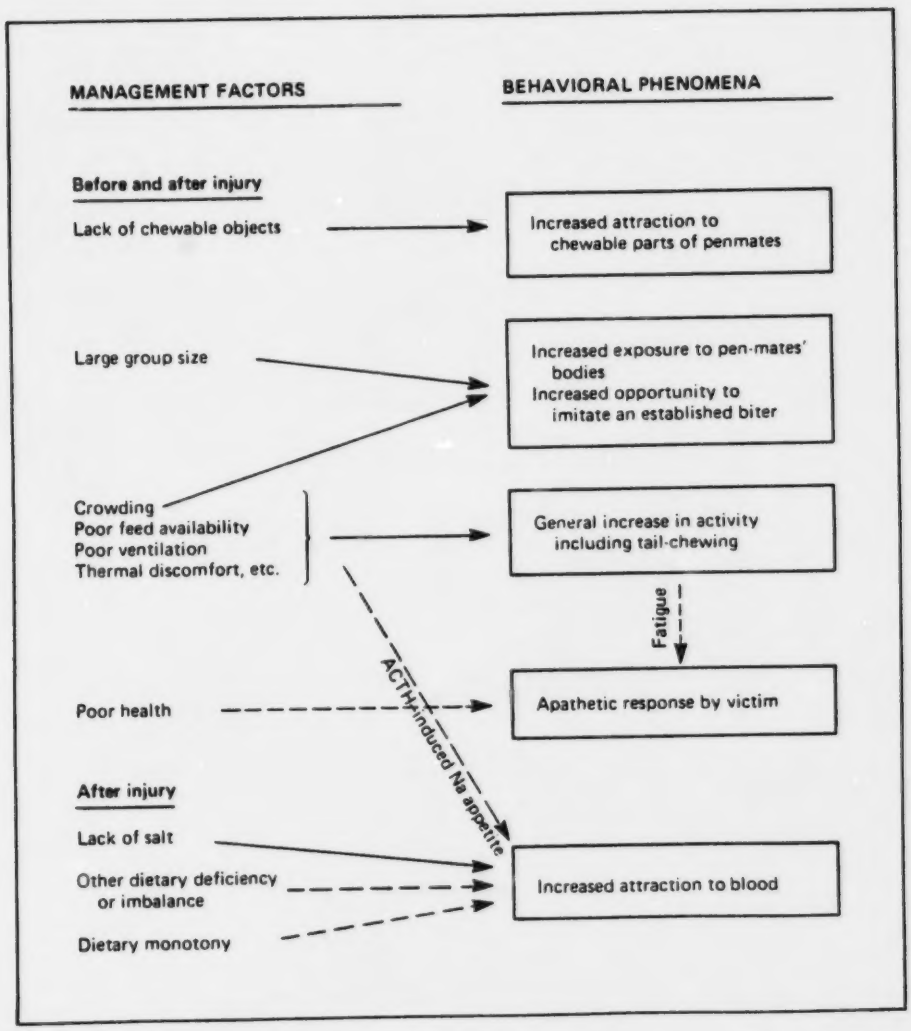

Fig. 3. Proposed model suggesting how management factors may influence behavioral phenomena favoring tail-biting. The more speculative relationships are shown with broken lines.

pattern, then various stressors could increase the animals' attraction to blood by means of an ACTH-induced increase in sodium appetite.

Because the causes of tail-biting are complex, it is important to clarify how an attraction to blood may fit with other factors. Fig. 3 summarizes a working hypothesis on how various management factors may influence behavioral phenomena that arguably increase the likelihood of a tail-biting outbreak.

The model suggests that a lack of straw or other chewable objects causes pigs to direct some of their normal exploratory and manipulatory behavior to the bodies of their pen-mates. This has been shown by research in Europe and at ARC. Large group size and over-crowding provide pigs with greater exposure to pen-mates (and therefore a greater opportunity to bite tails) as well as more opportunity to learn the behavior by imitating other pigs. Crowding, fighting, hunger, and other causes of discomfort may make the animals generally more restless and thus increase the frequency of many activities including chewing on tails. Ill health, or fatigue from excessive restless activity, may cause the recipient of tail-biting to react apathetically so that the behavior is more likely to persist to the point of causing injury.

Once the chewing of tails has caused a bleeding wound, then an attraction to blood could add a further impetus for the behavior to continue or escalate. At this stage, a lack of salt in the diet will increase the animals' attraction to blood, and various causes of stress might have a similar effect. Other dietary problems, such as low levels of fibre or protein, might also contribute, but experimental evidence is lacking. Finally, for an omnivore such as the pig, a monotonous diet may cause an object which provides a different flavor, such as that of blood, to be attractive simply because of its novelty.

The relationship between real tail-biting and the experimental simulation using artificial tail models is speculative, but the results lead me to predict: (1) that tail-biting outbreaks should be more serious under conditions (dietary, or possibly stress-related) that cause increased appetite for salt; and (2) that providing alternative sources of salt would reduce tail-biting under such conditions. It may also be that a chewable object, carrying a flavor that competes well with blood for the pig's attention, should be a useful device to help prevent or mitigate tail-biting problems.

(This report is based on Canadian Journal of Animal Science 67:909-918 (1987). The three figures and the verse are reprinted from the Journal.)

Attraction to Blood as a Factor in Tail-Biting by Pigs

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By nature, the pig is an animal that chews and roots at objects in its environment. In confinement housing, it is not surprising that some of this behaviour is directed at the tails of pen-mates. This is often seen as a low-key, harmless activity. However, it is not at all clear why this behaviour sometimes erupts, literally overnight, into outbreaks of persistent, damaging tail-biting. Poor environment (bad ventillation, over-crowding, dirty pens) seems to play an important part. However, a common and puzzling observation is that tail-biting may be a serious problem in some groups of pigs but not in others in the same barn. Even within pens, the behaviour is often confined to two or three individual pigs.

OBJECTIVE

An attraction to blood has sometimes been noted in studies of animal behaviour. The purpose of this experiment was to determine whether some pigs show an attraction to blood, as this could have considerable bearing on tail biting.

METHODS

Twelve weaned pigs, aged about 6 weeks, were housed in individual pens with feed and water ad lib. Each day for 12 days, two canvas "tail models" (canvas pieces approximately the length and width of a pig's tail) were attached to the pen gate for 12 min. One model had been soaked in 5 ml blood and allowed to dry overnight in the air; the other model remained plain. An observer scored the amount of time that the pigs spent chewing the two models.

The experiment involved twelve different pairs of tail models, each consisting of one blood-covered and one plain model. Each pair was used once with each pig, so that any possible differences among pairs of tail models would not be confused with differences among pigs. The positions of the blood-covered and plain models were alternated daily.

RESULTS

On average, the pigs showed a clear preference for chewing on the blood-covered models, but the differences among animals were as interesting as the overall effect. Some pigs chewed avidly on the models and showed a strong preference for the blood-covered model. For example, pig no. 3 (Table 1) spent 73% of the test time in chewing the models, and directed 87% of its chewing to the blood covered model. Other pigs had no preference for the blood-covered model, and some pigs showed little interest in chewing on the tail models at all. For example, pig no. 2 spent only 21% of the test time in chewing, and directed only 40% of this activity to the blood-covered model.

TABLE I Results (mean ± S.E.) of two behavioural measures for the 12 pigs presented each day with one blood-covered and one plain tail model

Pig number	Percentage of chewing directed at blood-covered model	Percentage of test time spent chewing models
3	87 ± 4**	73 ± 5
4	80 ± 3**	58 ± 3
12	71 ± 5*	43 ± 3
5	70 ± 8*	31 ± 4
10	68 ± 5*	28 ± 3
11	67 ± 6	7 ± 2
6	65 ± 5*	24 ± 4
7	62 ± 5	28 ± 4
1	55 ± 8	27 ± 6
8	54 ± 5	34 ± 5
9	50 ± 5	52 ± 5
2	40 ± 8	21 ± 5

Significantly more chewing on the blood-covered model (*P<0.01; **P<0.001).

DISCUSSION

This result, which we have fully confirmed in subsequent work, shows that certain pigs have a strong attraction to blood-covered objects and will quickly form the habit of chewing objects from which blood is available. This trait shows large individual differences among animals under the same conditions of environment and diet.

In my view, tail-biting outbreaks need to be divided into two stages. The first or "pre-injury" stage is before any tail injury has developed. At this stage, pigs will often be seen chewing and nibbling on pen-mates' tails, but the behaviour has a casual appearance, without the persistence and harassment that develop later. Attraction to blood likely plays no role at this stage. However, any poor environmental conditions (ventillation, crowding, temperature, etc.) can make the animals spend less time resting and more time active, and this could well increase the amount of tail-chewing. I suggest that this "harmless" chewing of tails, if sufficiently prolonged, will lead to some injury of the tail.

Once an injured tail is present in a pen, the second or "post-injury" stage begins. In this stage, if the pen includes one or more pigs with a strong attraction to blood, these animals can be expected to pursue the damaged tail with an eagerness that was not apparent in stage 1. It is a small step for such animals to learn that other tails, not yet damaged, will also yield blood if bitten sufficiently. In this stage, we can expect large differences between pigs and between pens, depending on the degree of attraction to blood shown by individual animals. Also, any dietary factors that increase the level of attraction to blood can be expected to make tail-biting more difficult to stop.

SIGNIFICANCE TO THE INDUSTRY

The above interpretation will not doubt have to be expanded and corrected as research develops. Also, some outbreaks of tail biting may develop in quite different ways. However, this interpretation provides a starting point that can be tested against research and farm experience as we try to develop a full understanding of the tail-biting problem.

KEY WORDS: Pigs, tail-biting.

FACILITY PROBLEMS IN FEEDER BARNS

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For presentation at Manitoba Swine Seminar,
February 23, 1989.

In the last decade, the farrowing and weanling areas have been the focus of many farmers wishing to improve the performance of their swine herd. Impressive advancements have been made in sow productivity and weanling pig growth through improved facilities, better management and more complete record keeping.

More recently, there is a growing interest in looking at the finishing side of the operation. The following are some of the problems in the finishing side that might be considered for improvement.

Factors Limiting Performance

Most certainly one of the major measures of finishing pig performance is feed efficiency. Many factors influence feed efficiency. The following table attempts to quantify these factors:

INCREASE IN FEED/GAIN DUE TO VARIOUS FACTORS

Multiple source pigs	0.2
More than 500 pigs in a room	0.2
Less than 8 sq.ft./pig at market weight	0.1
Continuous flow	0.25
Mortality increase of 1%	0.25
Feed waste	0.5
Mixing pigs with new penmates	0.2
Temperature below 15°C (per C°)	0.02
Temperature above 30°C (per C°)	0.02

One may argue with the number attributed to each factor and indeed the model has been difficult to verify. However, it does suggest that there is an inter relationship between various elements within a barn, and that a large number of things must be correct before an optimum performance is achieved.

Multiple Rooms, Common Side Alley

Large rooms with many animals is recognized as more difficult when try to keep health problems, both enteric and

respiratory in check. There is a trend to break these large rooms into smaller units.

There have been some larger finishing barns built with the common hallway down the side of the building to service the various rooms. These rooms have partially slatted floors with slats at both ends of the pen for better pen cleanliness. The solid section in the middle of the pens is heated with hot water pipes and used only when the pigs are small in the winter.

The inletting of air is through a porous ceiling known as the Even-Flow inlet. This involves a Styrofoam ceiling with slots 2' o.c. across the ceiling. The slots are covered with a stainless steel strip with 3/8" holes in it. Air may be preheated slightly in the hallway before it goes through this ceiling. Exhaust is through variable speed ceiling fans.

Multiple Rooms, Central Alleyway

For existing barns, side hallways are difficult and impractical to instal. In this case, many operators are simply building walls across the barn to break the large room into smaller units.

These may or may not be operated as all-in/all-out and does nothing to reduce pig flow through the barn. However, it does reduce the finishing room volume and does give a greater opportunity to clean a room out from time to time at a relatively low cost. With a manure pit common to all rooms, sealing of this pit between rooms with walls or curtains is an important detail for the ventilation.

Concrete Sandwich Wall Construction

Rodents, pigs and moisture are very hard on conventional stud walls with fibreglass insulation. Concrete sandwich wall construction was first introduced in the late seventies and in some areas of Ontario has become a very popular building technique today.

The most common form is the 12' high 10" thick wall with a 2" to 3" core of extruded polystyrene (Styrofoam). There will be 3' of this wall in the ground as the foundation and 9' above.

These walls used to carry a large premium, but over the years as the contractors gained more expertise in the technique, prices have fallen. Today, a concrete sandwich wall costs less than 10% more per lineal foot than an equivalent insulated stud wall. This represents less than a 2% premium on the total building cost.

Clean Pens

With partially slatted floors, messy pens can be a problem especially in hot weather. Many producers installed self feeders to reduce labor and feed wastage but were disappointed to find pens which were previously clean are now very dirty.

Several factors contribute to this. Self feeders located at the top of the pen rather than next to the slats (especially in pens of less than 8') are more of a problem. With high moisture corn it is desirable to have the feeders at the front for filling, adjustment and clean out.

Pen partitioning seems to have a big effect. With centre passage barns, closed side partitions (at least back to the slats) and closed front gates improved dunging habits significantly in tests completed recently at the University of Guelph. Spray cooling and redirecting incoming fresh air down into the sleeping zone in hot weather are also effective in keeping pigs clean.

Loading Facilities

Loading facilities have been very poor on many farms leading to too many injuries and higher than necessary PSE problems at the packing plants.

Many farmers have made improvements to their loading facilities in the last several years. Temple Grandin's work (University of Illinois) has help greatly in the design of acceptable chutes, pens, entrances etc. Many of her ideas are contained in the section on loading chutes in the CPS leaflet M-3002 "Site and Building Planning for Swine Production".

FEEDING AND MANAGEMENT OF GROWING-FINISHING HOGS

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[1]Presented at Manitoba Pork Days, February 1989.

Introduction

Feed costs account for 50 to 80% of the cost of production of pigs over the past 10 years. Therefore, to maximize profit we must ensure the most efficient use of feed on the farm. However, non-feed costs are also significant and the best way to reduce these fixed costs is to maximize the amount of pork produced on your unit. Therefore, in most cases the most efficient and profitable production will be achieved by selecting good quality breeding stock and maximizing their genetic potential for growth rate.

Genetics

It is well known that growth rate and feed conversion efficiency are 25 to 30% heritable and therefore can be improved quickly by selection of top quality breeding stock. Backfat thickness is even more highly heritable (50-60%) and therefore even faster progress can be made in improving the carcass quality of pigs. For the period 1982 to 1987 the average backfat thickness of boars tested at federal stations in Western Canada was 14.3 mm. Growth rate and feed and daily feed intake were 0.91 kg and 2.2 kg/day, respectively. The top 15% of these boars were growing at close to 1.2 kg/day and had 10 to 12 mm backfat. It is obvious that purchase of such top quality boars could quickly improve the level of pig performance in most swine units.

Maximizing Growth Rate

Some recent survey data in Alberta has shown that the average growth rate of growing-finishing hogs (20 to 100 kg) in some of our better farms is about 630 g/day with a range of 450 g/day to 820 g/day. On average farms the growth is probably about 550 g per day with pigs reaching market weight at 200 days. Pigs growing at 820 g/day reach a market weight of 100 kg 30 days sooner than pigs growing at 630 g/day and, therefore, an additional 80 pigs

could be put through a 100 pig unit in one year. It is obvious that fast growth rate can have a very significant influence on the profitability of a swine unit. The most important factors influencing growth rate and carcass quality are genetics, health, housing, nutrition and management.

Sick pigs grow slowly if at all. Having a closed herd, a good disinfection and sanitation program will greatly assist in allowing your pigs to express their genetic potential for growth. The greatest care and sanitation is obviously needed for the suckling and the newly weaned pig. The performance of a pig is influenced by the number of bacteria to which it is exposed, the virulence of the bacteria and the level of stress imposed upon it. Good management therefore means keeping the sows clean, the herd closed and the stress levels of the pigs as low as possible. Therefore, using a power washer and a good disinfectant in the barn will certainly pay in reduced incidence of disease. Some researchers have shown that practising an all-in all-out system in the growing-finishing barn will significantly increase the growth rate of pigs.

Housing

One of the important factors in housing is providing just the right amount of space per pig. Giving pigs too much space is obviously costly and wasteful but providing too little space will reduce feed intake and rate of gain and will increase fighting and tail biting. A rough guide to floor space requirements for pigs reared on partially slatted floored pens are:

Pig Weight (kg)	Space/pig (m^2)	Sq. Ft.
10 - 25	0.25	2.8
25 - 50	0.50	5.6
50 - 75	0.70	7.8
75 - 100	0.85	9.5

It is usually difficult to adjust floor space per pig as they get larger. Many producers adopt a system of splitting group size at about 50-55 kg and increasing floor space per pig at that time. Some effort to maximize use of expensive floor space and yet not overcrowd your pigs is desirable and cost effective.

Another potential problem with housing pigs is group size. There is some good evidence now that when group size goes over 16 pigs, that feed intake will decrease and so pigs will grow more slowly. The amount of activity and aggression in the pen will also increase as group size exceeds 15-16 pigs. Emptying time for a pen and days to market are therefore increased as the growth rate, particularly of the less aggressive pigs, is reduced. Providing adequate feeder space per pig and a continuous supply of good quality water is also essential. A rough guide is 50 mm (2 in) of feeder space for pigs of less than 25 kg, and 75 mm (3 in) for pigs from 25 to 100 kg. Many producers are now providing two well separated nipple drinkers per pen for group sizes of 20 or more. The nipple should be able to deliver at least two cups of water per minute.

Temperature

In spite of the fact that the need for adequate and stable temperatures in pig barns has been stressed for years, very few producers record maximum and minimum temperatures in their barns. The temperature minimum requirements of growing-finishing pigs have fairly well been determined to be 23°C for

growing (20-50 kg) and 20°C for finishing pigs (50-100 kg) pigs. It has been estimated that for every 1°C decrease in environmental temperature below the pigs critical (minimum) temperature, growth rate is reduced by 8-20 g/day. For grower pigs kept at 10°C (50°F), growth rate and feed conversion efficiency are 14% and 17% lower than at 20°C. Temperatures should be recorded at the level of the pig and daily fluctuations in temperature should be minimized. Drafts in the piggery will reduce the pigs comfort and if they are severe enough can reduce the effective temperature (that is, the temperature the pig feels) of the pig below its minimum requirement and thus decrease feed conversion efficiency and growth rate. It has been shown that for growing pigs kept at 20°C, an increase in air speed from 0.03 to 0.56 m per second reduced growth rate by 150 g per day. A draft of 1.5 m per second is equivalent to a drop in temperature of 10°C. It is obvious that air movement where the pigs are sleeping should be minimal.

High temperatures in the growing-finishing unit are also undesirable. Feed intake will be reduced by 1 g per kg of liveweight for every °C above the pigs critical temperature. Thus a finishing hog of 70 kg kept at a temperature of 25°C will eat 350 g (5 x 70) less than a pig kept at 20°C. This will obviously reduce growth rate and increase days to market.

Nutrition

Growth rate cannot possibly be maximized unless pigs are full fed a properly balanced diet. A balanced diet supplies all the nutrients in the correct amount, form and proportion to meet the pigs need for a particular function, e.g. growth, reproduction, lactation. The most important nutrient is the one that is deficient. The nutrients most likely to be deficient are lysine, energy, calcium and phosphorus. At times other nutrients such as

Vitamin E or biotin may be deficient. If a diet is imbalanced in any nutrient the feed intake of the pig is likely to decrease and performance will be significantly reduced. Corn, wheat, barley, canola meal, meat meal and soybean meal provide the basis for most swine diets in Canada. Other grain and protein sources are used at levels dictated by supply, quality and cost effectiveness. The best guide in North America to the nutrient requirements of growing-finishing pigs is that published by the National Academy of Sciences-National Research Council (NAS-NRC 1988). A summary of the suggested minimum requirements and allowances for some selected nutrients and energy is shown in Table 1.

Because the NRC values are suggested minimum requirements, some margin of safety should be added for pigs raised under commercial conditions. Table 1 also shows a suggested allowance level for growing-finishing pigs. It needs to be stressed that these recommendations assume proper environmental conditions. Furthermore, as can be seen in Table 1 the recommended feeding levels are based on a definite expectation of feed intake and growth rate. If pigs grow at faster rates or eat less then they must be fed higher energy diets containing higher nutrient levels. The energy and lysine requirements of pigs growing at two different growth rates are shown in Tables 2 and 3. A pig growing at 1000 g per day would reach a market weight of 100 kg in 146 days or less and would require 3.0 kg feed/d of a diet containing 3.0 Mcal DE/kg and 0.82% lysine. If the pigs appetite allowed only a feed intake of 2.25 kg/d then the diet would have to contain 4.0 Mcal DE/kg and 1.1% lysine to meet the pigs requirements. For a pig growing at 600 g/d and reaching a market weight of 100 kg in 206 days the pigs energy and lysine requirements would be met by eating 2.25 kg/day of a diet containing 3.0 Mcal DE/kg and

0.70% lysine. If both pigs are penned together we must decide whether to feed the high nutrient density diet in order to allow the expression of the genetic potential of pig A. In this case pig B will waste a great deal of the protein and will get very fat. On the other hand if we feed the more normal diet the superior pig will not be able to grow to its potential and will have much the same growth rate as pig B but will have less fat. This concept of the effects of feed intake or weight on fat and lean growth rates are presented in Figure 1. One pig (A) has a maximum genetic potential for 400 g lean/d. The other (B) has a potential growth rate of 600 g lean/d. When these potentials are reached the lean growth rate plateaus and if feed intake increases after this point more and more of this feed is used to deposit fat. Therefore, feed conversion efficiency gets worse and carcass quality gets poor. Unless diets are designed to match the pigs capacity for muscle growth the best pigs won't express their genetic potential and poor quality pigs are likely to get excess nutrients. Recent data from Guelph suggests that fast growing pigs may respond to dietary protein levels as high as 22% (Table 4).

A concern may be that leanness is associated with lower appetite. If this is so, then the leaner pigs with poor appetites may require very high nutrient density diets. It is important therefore to make an effort to know the growth rates and feed intakes of your pigs and to supply them with properly balanced diets to allow them to express their growth potential. Survey after survey indicates that the quality of feed produced on many farms is unsatisfactory. A survey taken in Manitoba in 1986 showed that producers were on average adding only 87% (range 40 to 150%) of the manufacturers recommended levels of supplement. Thus, many on-farm mixed diets do not meet the minimum nutrient requirement levels suggested by NRC and therefore reduced

pig performance could be expected, at least from the better quality pigs. Even in times of low pig prices it never pays to skimp on feed quality.

Summary

Major opportunities for improving production efficiency of growing-finishing pigs.

1. All-in, all-out production.
2. Select good quality breeding stock.
3. Don't overcrowd pigs, provide adequate space/pig, also adequate feeder space/pig.
4. Keep number of pigs per pen to 15 or less.
5. Make sure diets are properly mixed.
6. Use properly balanced diets and match the energy, lysine and other nutrient content of the diet to the pigs growth rate and feed intake.
7. Reduce feed particle size.
8. Temperature - Grower 23°C
   Finisher 20°C
9. Minimize feed wastage.
10. Keep disease levels low.
11. Minimize number of times pigs are mixed.
12. Efficiency and profitability of pig meat production will most likely be achieved by keeping superior strains of hogs. However, the potential benefits offered by these animals will not be fully realized unless improvement in their capacity for lean growth is matched by appropriate changes in their nutritional management.
13. Slaughter pigs at the correct market weights.

Table 1. Nutrient requirements[1] and recommended nutrient allowances of growing-finishing pigs.

	Requirement	Allowance[2]	Requirement	Allowance
Weight, kg	20-50	20-50	50-110	50-110
Daily gain, g	700	700	820	800
Feed/day, kg	1.90	1.90	3.10	3.10
Feed/gain	2.71	2.71	3.79	3.79
Energy, Mcal DE	3.26	3.20	3.28	3.20
Protein, %	15.0	16.0	13.0	14.0
Lysine, %	0.75	0.80	0.60	0.65
Ca., %	0.60	0.70	0.50	0.65
P., %	0.50	0.65	0.40	0.55

[1]Adapted from NRC (1988) Nutrient Requirements of Swine.
[2]Allowances have margins of safety added.

Table 2. Energy requirements of a 60 kg pig growing at two different rates: A: 1000 g/day and B: 600 g/day.

A. 1000 g = 600 g lean + 400 g fat
(days to market: 146)

B. 600 g = 300 g lean + 300 g fat
(days to market: 206)

Energy Requirement (Mcal DE/d)

	A	B
M	2.38	2.38
Lean	1.65	0.83
Fat	5.00	3.75
	9.03	6.96
Supplied by		
3 kg at 3.0 Mcal		2.3 kg at 3.0 Mcal
or		
2.25 kg at 4.0 Mcal		

Table 3. Lysine requirement of a 60 kg pig growing at two different levels: A: 1000 g/d and B: 600 g/d.

A. 1000 g/d = 600 g lean = 132 g Protein = 9.2 g lysine

B. 600 g/d = 300 g lean = 66 g Protein = 4.6 g lysine

Required in the diet:

	Pig A g lysine/d	Pig B g lysine/d
M	3.6	3.6
Lean	9.2	4.6
	12.8	8.2

M = maintenance.

Supplied by:

*2.25 kg at 1.1% lysine	2.25 kg at 0.7% lysine

*Assuming the protein in the diet has a biological value of 65% and a digestibility of 80%.

Table 4. Protein level for ROP boars (28 to 94 kg).

	% Protein		
	16	18	20
Gain/d, kg	0.93	0.96	0.99
Feed/d, kg	2.27	2.25	2.24
Feed/gain	2.43	2.33	2.27
B. fat, mm	15.0	14.1	13.2

Young, Kennedy, Klevorick, 1987.

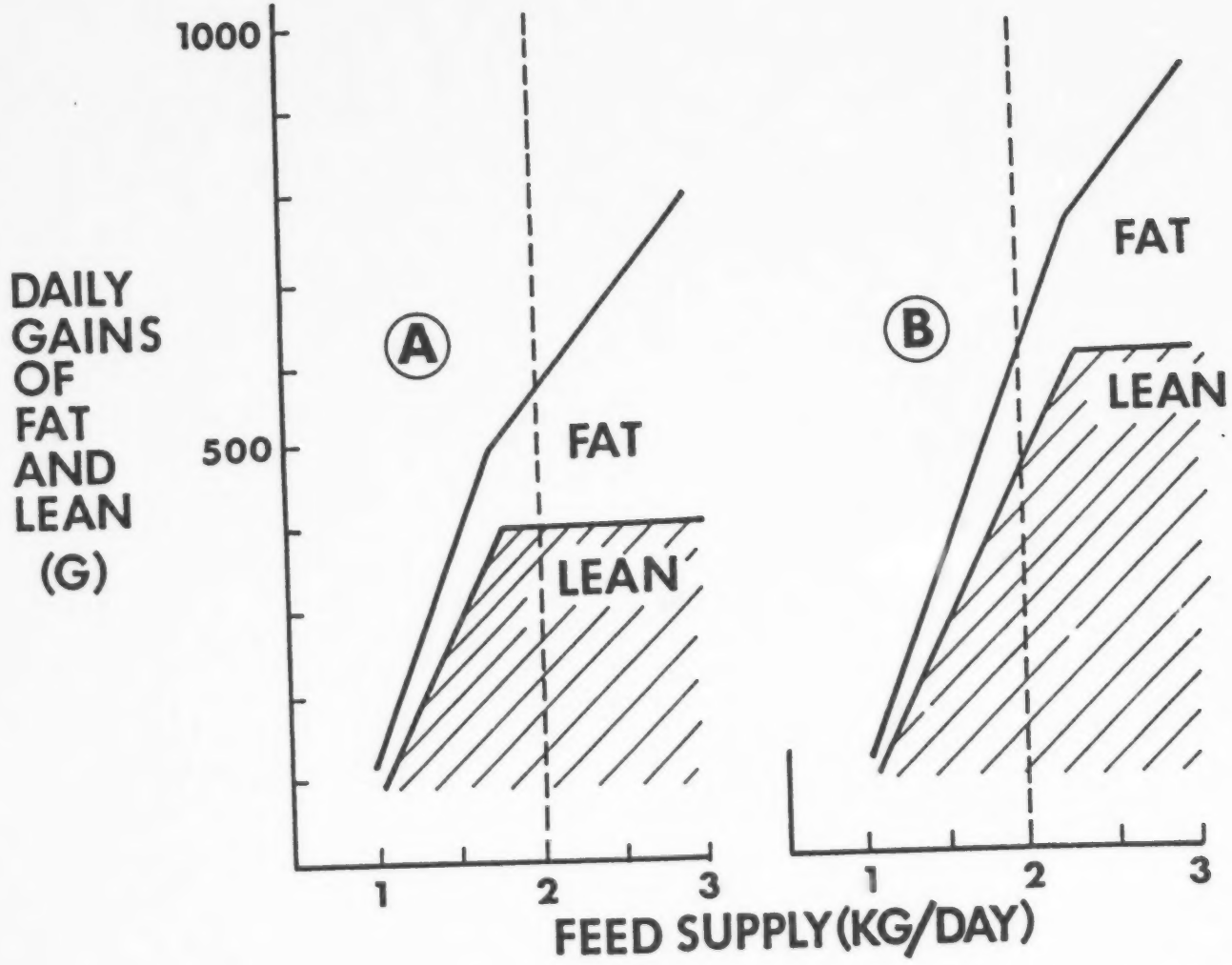

Figure 1. Daily gains of fat and lean in response to increasing feed supply. A, for pigs of unimproved type; B, for pigs of improved type (Whittemore 1988).

TROUBLESHOOTING VENTILATION PROBLEMS

by
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February 1989

The ventilation system is one of the most important yet least understood components in a livestock barn. Its main functions are to remove respired moisture, excess heat, gasses, odours and dust, while maintaining a comfortable, draft-free environment. This environment should provide comfort for the animals, not just the operator. The behaviour and productivity of the animals are the best clues to ventilation performance; if they are comfortable, they will look and act comfortable. For example, huddling and panting are common animal reactions to temperature extremes (too cold or too hot respectively).

One must appreciate that ventilation problems tend to be interrelated. That is, one problem often causes another. For example, consider the situation where a cross flow air inlet is open too wide. The main problem will be poor air distribution within the barn, but several other related problems will develop. Colder, incoming air will fall to the floor very quickly, creating drafts. Temperatures may not be uniform throughout the barn and the air will become damp because the respired moisture is not being adequately mixed and exhausted through the fans. By reducing the size of the air inlet, the incoming air is jetted into the barn creating better mixing and a good air circulation pattern. Not only has the air distribution problem been solved, but there is no longer a floor draft or uneven temperatures and more water vapour is being carried to the exhaust fan by the better mixed air. Sometimes such interrelationships can make the analysis of ventilation problems more difficult. Often you must make several

changes to completely solve a problem.

Ventilation is not a simple, exact science. You may feel very unqualified to evaluate a particular problem and then implement an appropriate solution. However, I suggest that each of you can and should be evaluating your barns with some simple instruments on a regular basis.

When attempting to troubleshoot any ventilation problem, it is important to thoroughly check the barn and document your findings. This information is particularly useful if you should later call on a ventilation consultant or other resource person to help you with this problem. How do you make a check of your barn? One very straightforward method is to obtain the answers to the following list of questions.

1. **What is the barn temperature?** This number is important to establish whether or not the barn is being maintained within the comfort zone of the particular size of animals being housed. Often times the producer will rely on the thermostat dial setting rather than a good thermometer. Unfortunately, thermostats quite regularly are found to be out of calibration by as much as 5 C°.

2. **What is the temperature fluctuation in the barn?** If this temperature fluctuation is greater than 3 C° one would suspect that the animals are being stressed. Some research has documented improved performance with a steady state temperature as opposed to a fluctuating temperature. On the other hand, there is some research indicating that a diurnal (overnight) temperature drop is perferred by pigs. The key point here is the fact that this temperature fluctuation occurs very slowly and thus would not be stressful. A minimum/maximum thermometer should be located

in each livestock room to monitor this temperature fluctuation. I have found a few barns where even though the temperature fluctuation was less than 3 C°, the pigs did not perform well. The installation of a recording thermohygrograph quickly revealed the fact that the room temperature was fluctuating the 2 C° every 10 minutes. Thus, a small but rapidly fluctuating temperature can also be very stressful.

3. **Are the pens drafty?** I have often been surprised at how different the conditions can be down in the pen where the pigs are as opposed to the feed passage. It is important to get into those pens occasionally and check conditions. The use of smoke can be very valuable in determining the direction of air flow and the location of drafts within the pen. An insect fogger with light mineral oil can create a large quantity of dense white smoke for visualization whereas a smoke pencil is valuable for smaller quantities of smoke within the pen itself.

4. **What is the air speed through the pen?** Although we do not know the absolute maximum air speed that can be tolerated by pigs, we do know, that a low air speed is preferred. Certainly, less than 50 ft/min (0.25 meters/sec.) is desired for small pigs. There are a number of air velocity instruments available for measuring this air speed. However, each of you carry a simple air speed meter with you all the time. Most people can perceive air speeds in excess of 50 ft/min (0.25 meters/sec) with the back of their wetted hand. If you can feel it then chances are its too fast.

5. **Are there obstructions at or near the air inlet?** Obstructions ahead of the air inlet baffle restrict the

supply of air making the fans work harder and cause excessive air inlet velocity. This condition often occurs on brand new barns by using screening along the soffit that is too fine. Another common occurrence is the installation of perforated soffit material which does not allow sufficient opening for the ventilation air. A restricted soffit opening can develop over time due to plugging by debris such as red dog from a grain drying operation on the farmstead. Corrugated metal ceilings with the ribs running opposite the air flow and electrical wiring are two common obstructions downstream of the inlet baffle that deflect the air jet down away from the ceiling surface prematurely. This reduces the mixing action within the barn and can cause pen drafts.

6. **Is the air inlet being controlled adequately?** If the inlet is not adjusted as necessary to maintain a high air inlet velocity then poor mixing and an undesirable air circulation pattern is likely. For crossflow ventilation systems the installation of a static pressure gauge will show the producer whether or not the air inlet is being adjusted properly. The use of recirculation ducts in conjunction with cross flow ventilation has reduced the necessity for such frequent inlet adjustments. Also the use of the self adjusting air inlet with counter-weights has been a vast improvement in the area of air inlet control.

7. **Are the fans sized properly?** Hopefully, the fans are sized such that there is a continuous running fan and thus no time without ventilation. As well, the fan

selection should follow the doubling rule for staging to prevent large increases in ventilation and have sufficient stages to reach maximum summer ventilation. Oversized fans have been a particular problem in small rooms where they cause very rapid temperature changes.

8. **Are the controls working properly?** The electro-mechanical thermostats commonly used for temperature control are simply automatic switches. Unfortunately, these switches can be wired to operate the equipment on temperature rise or temperature fall. It is amazing how many times we discover that fan thermostats are actually wired backwards, such that they stop on temperature rise and start on temperature fall. This can certainly cause a wide temperature flucuation within the barn. With time, thermostats tend to get dirty and corroded, such that the switching mechanism sticks. This also can lead to wide temperature differentials between off and on. Thermostats seem to have a habit of going out of calibration and should be checked regularly with a good thermometer.

This has been a brief look at how you would check your barn for ventilation problems. To help you further with these problems, you may wish to consult some of the resource material that is available. In particular I would draw your attention to two CPS leaflets; M-9702 Troubleshooting Livestock and Poultry Ventilation Problems and M-9703 Ventilation Instruments.

If you have difficulty in solving a problem, you may wish to contact someone with some ventilation expertise. First try the equipment supplier who should be able to correct any equipment malfunctions. Often the equipment is installed and/or wired incorrectly. Contact your building contractor and/or the electrician for these types of problems. Your herd health

veterinarian is often able to help you identify a ventilation problem. Another very good resource person for helping with ventilation troubleshooting is your Agricultural Extension Engineer.

The following pages represent a handout given to the audience during Dr. Rueff's presentation. Remarks during the presentation referred to specific points in the handout and are available on videotape. Please contact the people listed in the front of these proceedings if you wish to obtain the tape.

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LARRY RUEFF, D.V.M. ED KLUBER, D.V.M., M.S.

FORMULATING A GAME PLAN TO ACHIEVE PRODUCTION TARGETS

Larry Rueff, DVM
Greensburg, Indiana

February 23, 1989

PERFORMANCE MONITOR
1 SEP 86 - 30 NOV 87
FARM:

PigCHAMP 2.1
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ROLLING AVERAGES	SEP 86 AUG 87	OCT 86 SEP 87	NOV 86 OCT 87	DEC 86 NOV 87
BREEDING PERFORMANCE				
Total number of services	205	235	241	257
Percent repeat services	11.7	14.0	15.8	14.8
Percent multiple matings	3.9	3.4	3.3	0.0
Weaning - 1st service interval	10.7	10.1	9.6	9.6
Percent sows bred by 7 days	86.3	87.6	93.0	93.1
Entry - 1st service interval	7	6	5	5
Ave non-productive sow days	158.3	152.6	144.2	136.2
FARROWING PERFORMANCE				
Number of sows farrowed	140	143	147	158
Ave parity of farrowed sows	2.6	2.7	2.7	2.7
Total pigs born alive	1256	1281	1319	1422
Average total pigs per litter	9.8	9.8	9.9	9.9
Average pigs born alive/litter	(6) 9.0	9.0	9.0	9.0
Average stillborn pigs	0.8	0.8	0.7	0.7
Percent stillborn pigs	7.7	8.0	7.5	7.4
Average mummies per litter	0.1	0.1	0.1	0.1
Percent mummies	1.0	1.0	1.4	1.3
Average litter birth weight	1.0	1.0	1.0	1.0
Farrowing rate	56.0	55.9	55.7	59.8
Farrowing interval	181	179	191	188
Pigs weaned per sow farrowed	7.2	7.5	7.7	7.7
Litters / mated female / year	(2) 1.43	1.44	1.46	1.55
Litters / female / year	1.38	1.40	1.43	1.53
WEANING PERFORMANCE				
Number of litters weaned	153	130	144	151
Total pigs weaned	(4) 1090	955	1068	1155
Pigs weaned per litter	(5) 7.1	7.3	7.4	7.6
Pre-weaning mortality	18.8	17.0	15.9	13.2
Average weaning weight	.	.	.	.
Average age at weaning	27.3	27.8	28.0	28.3
Adjusted 21 day litter weight	.	.	.	.
Pigs weaned/mated female/year	(3) 11.4	9.8	10.7	11.4
Pigs weaned / female / year	10.8	9.4	10.4	11.2
POPULATION				
Ending female inventory	(1) 106	110	104	111
Average parity	1.8	1.7	1.5	1.2
Average female inventory	103.4	103.7	104.3	105.6
Average gilt pool inventory	0.7	0.7	0.7	1.2
Gilts entered	57	65	75	89
Sows and gilts culled	50	50	56	60
Sow and gilt deaths	7	6	6	5
Sows and gilts transferred	1	4	4	4
Ending boar inventory	0	0	0	0
Replacement rate	56.1	63.7	72.9	85.2
Culling rate	48.4	48.2	53.7	56.8
Death rate	6.8	5.8	5.8	4.7

PERFORMANCE MONITOR
1 JAN 87 - 31 OCT 88
FARM

PigCHAMP 2.1
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ROLLING AVERAGES	JAN 87 DEC 87	FEB 87 JAN 88	MAR 87 FEB 88	APR 87 MAR 88	MAY 87 APR 88	JUN 87 MAY 88	JUL 87 JUN 88	AUG 87 JUL 88	SEP 87 AUG 88	OCT 87 SEP 88	NOV 87 OCT 88
BREEDING PERFORMANCE											
Total number of services	277	251	278	279	285	292	266	268	299	304	308
Percent repeat services	16.2	13.9	12.9	14.0	14.4	14.0	10.9	10.8	10.7	9.2	7.8
Percent multiple matings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3
Weaning - 1st service interval	8.8	4.5	4.6	4.6	4.4	4.3	4.1	4.1	4.5	4.5	4.5
Percent sows bred by 7 days	96.4	98.5	98.6	98.7	98.7	98.8	100.0	100.0	98.9	99.0	99.0
Entry - 1st service interval	5	5	5	4	4	3	3	3	3	4	4
Ave non-productive sow days	129.5	123.6	116.2	109.4	102.5	94.4	85.1	76.4	68.0	60.3	56.4
FARROWING PERFORMANCE											
Number of sows farrowed	156	160	183	189	197	210	197	214	225	239	241
Ave parity of farrowed sows	2.7	2.6	2.5	2.4	2.3	2.3	2.3	2.3	2.3	2.4	2.3
Total pigs born alive	1405	1459	1656	1711	1798	1909	1791	1967	2050	2172	2199
Average total pigs per litter	9.9	10.1	10.0	10.0	10.1	10.1	10.1	10.2	10.1	10.2	10.3
Average pigs born alive/litter (6)	9.0	9.1	9.0	9.1	9.1	9.1	9.1	9.2	9.1	9.1	9.1
Average stillborn pigs	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.1
Percent stillborn pigs	7.8	8.1	8.3	8.6	8.8	8.8	9.0	8.8	8.8	9.8	10.3
Average mummies per litter	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Percent mummies	1.3	1.2	1.1	1.0	0.9	0.9	1.0	1.0	1.2	1.2	0.8
Average litter birth weight	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.	.	.	.
Farrowing rate	58.6	61.3	62.7	63.0	63.1	67.3	69.1	69.5	69.9	71.8	72.4
Farrowing interval	190	194	195	192	185	178	179	176	174	173	164
Pigs weaned per sow farrowed	7.7	7.8	7.8	8.1	8.2	8.1	8.1	8.1	8.1	7.9	7.8
Litters / mated female / year (2)	1.52	1.55	1.76	1.79	1.84	1.93	1.78	1.91	1.98	2.09	2.10
Litters / female / year	1.50	1.54	1.74	1.77	1.82	1.90	1.77	1.89	1.97	2.08	2.08
WEANING PERFORMANCE											
Number of litters weaned	161	177	156	184	190	200	212	194	203	225	239
Total pigs weaned (4)	1230	1368	1210	1429	1524	1625	1706	1567	1649	1812	1883
Pigs weaned per litter (5)	7.6	7.7	7.8	7.8	8.0	8.1	8.0	8.1	8.1	8.1	7.9
Pre-weaning mortality	13.6	13.0	13.1	12.4	10.0	10.2	10.9	11.3	11.2	11.2	12.9
Average weaning weight	.	.	.	.	.	.	.	.	.	.	.
Average age at weaning	27.5	27.3	26.5	26.9	27.5	27.9	28.3	28.4	28.5	28.5	28.5
Adjusted 21 day litter weight	.	.	.	.	.	.	.	.	.	.	.
Pigs weaned/mated female/year (3)	12.0	13.3	11.7	13.7	14.4	15.1	15.6	14.1	14.7	15.9	16.5
Pigs weaned / female / year	11.9	13.2	11.6	13.6	14.3	14.9	15.4	14.0	14.6	15.8	16.4
POPULATION											
Ending female inventory (1)	122	124	122	121	122	118	123	122	125	135	132
Average parity	1.1	1.1	1.3	1.3	1.4	1.6	1.6	1.7	1.8	1.9	1.9
Average female inventory	107.6	109.6	110.8	112.3	113.6	114.5	115.1	116.2	117.4	119.2	122.0
Average gilt pool inventory	1.3	1.3	0.9	0.8	0.7	0.7	0.7	0.6	0.6	0.7	0.8
Gilts entered	94	95	85	90	88	86	92	78	83	85	79
Sows and gilts culled	58	64	61	58	60	69	67	58	53	52	42
Sow and gilt deaths	5	5	5	4	2	2	1	1	0	0	1
Sows and gilts transferred	4	4	6	6	9	10	10	11	11	8	8
Ending boar inventory	0	0	0	0	0	0	0	0	0	0	0
Replacement rate	87.4	86.7	76.5	79.9	77.3	74.9	79.7	66.9	70.5	71.1	64.6
Culling rate	53.9	58.4	54.9	51.5	52.7	60.1	58.1	49.8	45.0	43.5	34.3
Death rate	4.6	4.6	4.5	3.6	1.8	1.7	0.9	0.9	0.0	0.0	0.8

PARITY DISTRIBUTION REPORT
1 AUG 85 - 31 JUL 86
FARM:

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	PARITY 0	1	2	3	4	5	6+	ENTIRE HERD
BREEDING PERFORMANCE								
Total number of services	27	1	27	20	0	0	0	75
Percent repeat services	0.0	0.0	0.0	5.0	.	.	.	1.3
Percent multiple matings	3.7	0.0	0.0	0.0	.	.	.	1.3
Weaning - 1st service interval	.	36.0	.	22.5	.	.	.	23.2
Percent sows bred by 7 days	0.0	0.0	0.0	21.1	.	.	.	20.0
Ave non-productive sow days	129.4	304.7	365.0	231.3	.	.	.	282.3
FARROWING PERFORMANCE								
Number of sows farrowed	0	4	0	47	1	0	0	52
Total pigs born alive	.	37	.	460	15	.	.	512
Average total pigs per litter	.	10.0	.	11.0	15.0	.	.	11.0
Average pigs born alive/litter	.	9.2	.	9.8	15.0	.	.	9.8
Average stillborn pigs	.	0.8	.	1.2	0.0	.	.	1.2
Percent stillborn pigs	.	7.5	.	11.2	0.0	.	.	10.6
Average mummies per litter	.	0.0	.	0.0	0.0	.	.	0.0
Percent mummies	.	0.0	.	0.0	0.0	.	.	0.0
Litters less than 7 born live	.	0	.	6	0	.	.	6
Percent < 7 born live	.	0.0	.	12.8	0.0	.	.	11.5
Average litter birth weight	.	.	.	.	.	.	.	.
Farrowing rate	.	100.0	.	100.0	100.0	.	.	100.0
Farrowing interval	.	.	.	.	.	.	.	.
WEANING PERFORMANCE								
Number of litters weaned	0	4	0	47	1	0	0	52
Total pigs weaned	.	31	.	295	12	.	.	338
Pigs weaned per litter	.	7.8	.	6.3	12.0	.	.	6.5
Pre-weaning mortality	.	16.2	.	32.5	7.7	.	.	30.6
Net foster	.	0	.	9	-2	.	.	7
Average weaning weight	.	.	.	.	.	.	.	.
Average age at weaning	.	22.5	.	24.5	44.0	.	.	24.8
Adjusted 21 day litter weight	.	.	.	.	.	.	.	.
POPULATION								
Ending female inventory	(1) 60	4	0	39	1	0	0	104
Percent of female inventory	57.7	3.8	.	37.5	1.0	.	.	100.0
Females entered	29	1	85	1	0	0	0	116
Sows and gilts culled	2	0	1	7	0	0	0	10
Sow and gilt deaths	0	0	1	1	0	0	0	2
Average female inventory	6.7	1.5	16.6	7.9	0.2	0.0	0.0	32.9

PARITY DISTRIBUTION REPORT
1 NOV 87 - 31 OCT 88
FARM:

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	PARITY							ENTIRE
	0	1	2	3	4	5	6+	HERD
BREEDING PERFORMANCE								
Total number of services	96	73	70	42	22	4	1	308
Percent repeat services	18.8	5.5	1.4	2.4	0.0	0.0	0.0	7.8
Percent multiple matings	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.3
Weaning - 1st service interval	.	4.7	4.1	4.0	5.9	4.0	4.0	4.5
Percent sows bred by 7 days	0.0	98.6	100.0	100.0	95.5	100.0	100.0	99.0
Ave non-productive sow days	88.0	3.9	-36.1	-7.5	10.1	105.6	23.0	21.6
FARROWING PERFORMANCE								
Number of sows farrowed	0	79	71	48	30	10	3	241
Total pigs born alive	.	675	665	479	258	100	22	2199
Average total pigs per litter	.	9.5	10.4	11.0	10.5	11.5	10.3	10.3
Average pigs born alive/litter	.	8.5	9.4	10.0	8.6	10.0	7.3	9.1
Average stillborn pigs	.	0.9	1.0	0.9	1.7	1.4	2.3	1.1
Percent stillborn pigs	.	9.6	9.6	7.8	15.9	12.2	22.6	10.3
Average mummies per litter	.	0.0	0.0	0.1	0.2	0.1	0.7	0.1
Percent mummies	.	0.4	0.4	1.1	1.9	0.9	6.5	0.8
Litters less than 7 born live	.	12	6	5	5	1	1	30
Percent < 7 born live	.	15.2	8.5	10.4	16.7	10.0	33.3	12.4
Average litter birth weight	.	.	.	.	.	.	.	.
Farrowing rate	.	64.2	70.3	90.6	81.1	71.4	60.0	72.4
Farrowing interval	.	.	163	166	163	159	203	164
WEANING PERFORMANCE								
Number of litters weaned	0	74	72	44	34	10	5	239
Total pigs weaned	.	568	570	356	267	87	35	1883
Pigs weaned per litter	.	7.7	7.9	8.1	7.9	8.7	7.0	7.9
Pre-weaning mortality	.	11.8	12.7	14.4	14.4	9.4	14.6	12.9
Net foster	.	17	-9	-24	4	-1	3	-10
Average weaning weight	.	.	.	.	.	.	.	.
Average age at weaning	.	27.5	28.2	30.0	29.4	28.0	26.6	28.5
Adjusted 21 day litter weight	.	.	.	.	.	.	.	.
POPULATION								
Ending female inventory	28	28	30	25	17	3	1	132
Percent of female inventory	21.2	21.2	22.7	18.9	12.9	2.3	0.8	100.0
Females entered	79	0	0	0	0	0	0	79
Sows and gilts culled	8	5	5	4	10	7	3	42
Sow and gilt deaths	0	0	0	1	0	0	0	1
Average female inventory	35.8	32.1	25.2	16.9	8.1	2.8	0.3	121.3